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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management ond Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientitsts, engineers, and managers as one of several services of the Water Resources Scientific Information Center. The cumulative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

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Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

SYNTHESIS AND HIGH PERFORMANCE LIQUID CHROMATOGRAPHY OF OMEGA-(3-SUBSTITUTED-2-OXO-1-PYRIDYL)-ALKYLSULFONATES FOR USE AS WATER TRACING COMPOUNDS,
Wyoming Univ., Laramie. Coll. of Arts and Sciences.
D. A. Nelson, and D. M. Lenz.
Water Research Center Completion Report, September 1983. 22 p, 2 Fig, 4 Tab, 18 Ref. OWRT A-038-WYO(1), 14-34-0001-2154.

Descriptors: *Tracers, Chemical composition, Fluorescence, *Liquid chromatography.

Six new compounds for use as water tracers were synthesized by alkylation of the sodium salts of 3-phenyl-2-pyridone and 3-carbamoyl-2-pyridone with Br (CH sub 2) sub x SO sub 3 super - Na super +, where x = 2, 3, and 4. These omega-(3-substituted-2-oxo-1-pyridyl)-alkylsulfonates are strongly fluorescent, and can be detected at the part-per-trillion level. They are chemically stable and resist absorption in the environment. The compounds are designed to be separated by ion-pairing reversed phase high performance liquid chromatographic (HPLC) techniques, with fluorescence detection. These properties make the compounds uniquely suited for site-specific water tracers.
W84-00635

2. WATER CYCLE

2A. General

DISCUSSION: ASPECTS OF HYDROLOGY IN THE PROVINCE OF NORTH SUMATRA, INDONESIA,
J. Wild, and J. K. Hall.
Proceedings of the Institution of Civil Engineers, Part 2: Research and Theory, Vol 73, No 4, p 829-835, December, 1982. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Hydrology, *Runoff, Sumatra, Indonesia, Climatic data, Rainfall-runoff relationships, Geohydrology, River flow, Evapotranspiration, Floods, Groundwater.

The above titled paper, published in Proceedings of the Institution of Civil Engineers, Part 2, Volume 73, pages 85-108, March 1982, prompted a comment by J. R. Wood and M. J. Hall about the hydrology of West Sumatra. North and West Sumatra are similar in physical geography and have similar hydrometric networks. However, climatic parameters vary widely in space, time, and degree. West Sumatra has an average annual rainfall of 3935 + or - 714 mm. Drought can occur in June and July. R. B. Bulman raised several questions about relationships derived from the rainfall and runoff data. The authors replied to the comments, adding that river flows are governed by the geologic nature of the basins, which are recent volcanic, mixed volcanic, old volcanic, and sediments. Recent volcanic soil deposits have the greatest infiltration rates and the least runoff. (Cassar-FRC)
W84-00351

ROLE OF GLACIERS IN WATER EXCHANGE IN THE USSR,
A. N. Krenke.
Water Resources (English Translation), Vol 9, No 3, p 254-262, May-June, 1982. 2 Fig, 2 Tab, 26 Ref. Translated from Vodnye Resursy, No 3, p 47-56, May-June, 1982.

Descriptors: *Hydrologic cycle, *Glacier mass balance, *Water exchange, *Runoff, USSR, Basins, Oceans, Artic Ocean, Caspian Sea, Azov Sea, Black Sea, Bering Sea, Water levels, Water supply, Precipitation, Advection.

The completion of cataloging of the glaciers of the USSR and the development of a method for estimating the average depth of accumulation of moisture in glacial systems will make it possible to evaluate the role of glaciation in water exchange in the USSR. The total mass of USSR glaciers, equal to the volume of water being held in them, is estimated by indirect calculations made by various methods and using available geophysical data at 17,000 billion metric tons, i.e., 17,000 cu km. The 25 cu km of moisture annually accumulated by mountain glaciation and the 12 cu km entering the delayed ice cycle are very small quantities by comparison. Glaciation plays a slightly greater role in the moisture cycle of the mountainous part of Central Asia. Here the resultant advection of moisture to a territory of 485,000 sq km is equal annually to about 520 cu km, and the outflow is 400 cu km. When examining glacial runoff and its significance for the water balance in large basins it is noted that the Arctic Ocean receives 26 cu km of water annually from the insular ice caps. More than 2 cu km of glacial water is delivered to this ocean by rivers. In the runoff of rivers to the Bering Sea and the open part of the Pacific Ocean glacial waters amount to 0.8%, and in the runoff to the Okhotsk Sea to only 0.1%. The Azov and Black Seas annually receive from the USSR territory 1.93 cu km of glacial waters, which is apparently equal to half of the glacial waters in these areas. The Caspian Sea receives 1.23 cu km of glacial waters from the Caucasus, or 0.4% of the total runoff to this sea. The only large basin in the USSR where the role of glacial waters in the structure of the annual water balance is quite noticeable is the basin of the Aral Sea. (Baker-FRC)
W84-00381

THE WORLD OCEAN AND ITS ROLE IN PLANETARY MOISTURE, HEAT, AND SALT EXCHANGE,
V. N. Stepanov.
Water Resources (English Translation), Vol 9, No 3, p 217-237, May-June, 1982. 4 Fig, 10 Tab, 39 Ref. Translated from Vodnye Resursy, No 3, p 4-28, May-June, 1982.

Descriptors: *Oceans, *Ocean circulation, *Water exchange, *Hydroiogic budget, *Salinity, Salts, Evaporation, Runoff, Continental runoff, Ocean climates.

The Concept of the hydrosphere as a unified envelope of the earth is valid only in that the waters of the planet are linked by a global cycle. In regions where evaporation predominates over the amount of precipitation an increase in salinity of the surface waters of the ocean occurs; salinity convection develops, causing stratification and many other characteristics of the oceanosphere at low latitudes. At the same time the air is saturated with water vapor which is carried landward, due to which the surplus wetting of tropical territories occurs. Moisture exchange is directly related to salt exchange; this pertains not only to the oceanosphere and atmosphere, but also to land waters. During the action of wind waves, spraying of water occurs, leading to the ejection of salts into the atmosphere. Consideration is also given in this review to the distribution of water and land and the size of oceans, the areas and volumes of waters within the main morphological parts of the ocean bottom, the volumes of characteristic water layers, the exchange of energy and materials and planetary processes, solar energy and its role in global mass transport and redistribution, the cyclic nature of development of planetary processes, moisture exchange of the world ocean and the global hydrologic cycle, evaporation, precipitation, continental runoff, moisture budget of the world ocean surface, freshwater balance in the world ocean, heat exchange of the world ocean and its relation to planetary heat and moisture exchange, absorbed solar radiation, expenditure of heat on evaporation, turbulent heat exchange with the atmosphere, heat balance of oceans, estimations of the exchange of salts of the world ocean with the atmosphere and land, components of salt exchange through the ocean surface, and salt exchange between ocean and land. (Baker-FRC)
W84-00382

EVALUATION OF MAXIMUM LIKELIHOOD PARAMETER ESTIMATION TECHNIQUES FOR CONCEPTUAL RAINFALL-RUNOFF MODELS: INFLUENCE OF CALIBRATION DATA VARIABILITY AND LENGTH OF MODEL CREDIBILITY,
Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, V. K. Gupta, and J. L. Fulton.
Water Resources Research, Vol 19, No 1, p 251-259, February, 1983. 5 Fig, 5 Tab, 24 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Calibrations, Maximum likelihood estimates, Leaf River, Mississippi, Streamflow, Runoff, Error analysis.

The performances of two maximum likelihood estimators were compared with the simple least squares (SLS) criterion using the soil moisture accounting model of the U.S. National Weather Service's River Forecast System (SMA-NWSRFS). Data from the Leaf River Basin, Mississippi, included 18 years of precipitation, daily potential evapotranspiration estimates, and mean daily streamflow discharge rates. The maximum likelihood estimators were AMLE, which assumes the presence of first lag autocorrelated homogeneous variance errors, and HMLE, which assumes the presence of uncorrelated inhomogeneous variance errors. HMLE provided more realistic parameter estimates and more reliable forecasts and was less affected by the nature and length of data used for calibration. The SLS and AMLE, similar to each other in performance, were quite sensitive to variability and length of data. (Cassar-FRC)
W84-00397

AUTOMATIC CALIBRATION OF CONCEPTUAL RAINFALL-RUNOFF MODELS: THE QUESTION OF PARAMETER OBSERVABILITY AND UNIQUENESS,
Case Western Reserve Univ., Cleveland, OH.
S. Sorooshian, and V. K. Gupta.
Water Resources Research, Vol 19, No 1, p 260-268, February, 1983. 8 Fig, 1 Tab, 19 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Calibrations, Maximum likelihood estimates, Leaf River, Mississippi, Streamflow, Runoff, Error analysis.

Problems in automatic calibration of conceptual rainfall-runoff models are reviewed. The most important of these problems is an inability to obtain unique and conceptually realistic parameter sets because of poor properties of the response surface. Most models cannot be properly identified even with synthetic data because of inadequacies in the model structure and in the automatic techniques used for calibration. An analysis of the SMA-NWSRDS model using the simple least squares criterion and the HMLE maximum likelihood estimator showed that the latter greatly improved the parameter estimates obtained through calibration because it has the ability to recognize and account for heteroscedasticity in the residuals. (Cassar-FRC)
W84-00398

UNIQUENESS AND OBSERVABILITY OF CONCEPTUAL RAINFALL-RUNOFF MODEL PARAMETERS: THE PERCOLATION PROCESS EXAMINED,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
V. K. Gupta, and S. Sorooshian.
Water Resources Research, Vol 19, No 1, p 269-276, February, 1983. 8 Fig, 1 Tab, 12 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Calibrations, Runoff, Streamflow, Percolation, Infiltration, Error analysis.

The failure to obtain unique estimates for the parameters of conceptual rainfall-runoff models can be partly corrected by appropriate reparameterizations of the pertinent model equations. This was done for the percolation equation of the National Weather Service River Forecast System model. A unique optimum parameter set was observed without having affected the original behavior of the

model or altering the conceptual realism of the parameters. These results may be extended to other models and to other structures within the models which cause problems in calibration. (Cassar-FRC)
W84-00399

MODELING EROSION ON LONG STEEP SLOPES WITH EMPHASIS ON THE RILLING PROCESS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W84-00445

PREDICTIVE MODELS FOR ESTIMATING NET RAINFALL AND INTERCEPTION LOSSES IN SAVANNA VEGETATION,
Durban-Westville Univ. (South Africa). Dept. of Geography.
G. Du T. De Villiers.
Water SA, Vol 8, No 4, p 208-212, 1982. 5 Fig, 7 Tab, 16 Ref.

Descriptors: *Model studies, *Rainfall, *Interception, Water loss, Savanna, Vegetation.

Predictive models have been formulated from existing savanna interception data. While interception experimental plot results vary, research indicates that similarities do exist. Independent plot results therefore should be able to be grouped together for application on a regional basis. Throughfall measurements were surprisingly similar under different canopy conditions. Stemflow, highly variable in savanna vegetation covers, is nevertheless predictable from gross rainfall records, and although the average stemflow per storm is often less than 5% of the gross rainfall, it represents a concentrated application of water to soil at a point where conditions are ideal for entry. Sufficient water is added to the soil to cause wetting to considerable depth. For the storms that have been investigated, interception losses for savanna vegetation vary in most cases between 15 and 20% of the gross rainfall, which is far from an insignificant quantity of water. The evaporation rate and the rainfall rate are primary variables influencing this loss. Interception losses in savanna vegetation are not greatly affected by a variety of canopy conditions. Data concerning the rainfall characteristics and the evaporation rate of essential for an accurate estimation of interception losses. (Baker-FRC)
W84-00524

HYDROLOGY OF AREA 15, EASTERN COAL PROVINCE, KENTUCKY AND TENNESSEE,
Geological Survey, Louisville, KY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00543

DESIGN RAINFALL DISTRIBUTIONS FOR THE STATE OF WYOMING,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
P. T. Tyrrell, and V. R. Hasfurther.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132513, Price codes: A03 in paper copy, A01 in microfiche. Water Research Center Completion Report, August 1983. 41 p, 4 Fig, 11 Tab, 26 Ref. OWRT A-036-WYO(1), 14-34-0001-2154.

Descriptors: Rainfall-runoff relationships, *Rainfall distribution, Hyetographs, Flood frequency, Synthetic hydrology, Parametric hydrology, *Flood forecasting, *Design storms, *Wyoming.

Design storm patterns for use in predicting floods by simulating precipitation events in ungaged drainage basins in Wyoming are presented. The design patterns were developed from observed rainfall and are separated into two categories: thunderstorms (events less than four hours in duration) and general storms (events lasting four or more hours). Comparisons of predicted runoff using the new design storms and design storms recommended by the U.S. Soil Conservation Service and the Bureau of Reclamation were made using HEC-1, HYMO, and SCS Triangular Hydrograph and U.S.G.S. distributed routing digital rainfall-runoff models. The new design storms typically produce greater runoff peaks when simulating thunderstorm events, and smaller peaks when simulating runoff from general storms, than those predicted with the established procedures. Instructions describing the use and limitations of the new storm pattern construction method are included.
W84-00638

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2A: SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00661

WATER RESOURCES DATA--VIRGINIA, WATER YEAR 1982,
Geological Survey, Richmond, VA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00662

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 2. EASTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00663

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 1. WESTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00664

WATER RESOURCES DATA FOR ARIZONA, 1981.
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00665

WATER RESOURCES DATA FOR PENNSYLVANIA WATER 1981, VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00666

2B. Precipitation

SELECTED CLIMATIC CHARACTERISTICS OF THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. Water Resources Div.
S. D. Waltemeyer.
USGS Open-File Report 82-91 (WRI), 1982. 33 p, 22 Fig, 5 Tab, 20 Ref.

Descriptors: *Hydrologic data, *Climatic data, *Regional analysis, *Networks, Monitoring, Oil shale, Precipitation, Air temperature, Evaporation, *Utah, *Colorado, Uinta Basin.

The southeastern Uinta Basin in Utah and Colorado contains large reserves of oil shale, the mining of which could affect the area's water resources. Climatic characteristics of the area, which were evaluated as one phase of a comprehensive hydrologic study, are presented to help provide the means of evaluating the impact of mining on the area's water resources. Data for precipitation, air temperature, and evaporation obtained by the U.S. Geological Survey from October 1974 to September 1978, and similar short-term data obtained by other Federal agencies at sites in and near the study area, were tabulated and adjusted to a 1941-70 base period. For all sites with incomplete records for 1941-70, the data were adjusted by relating them to concurrent data collected at one or more long-term National Oceanic and Atmospheric Administration sites. Maps were prepared showing areal variance for normal annual precipitation, normal annual air temperature, and normal annual pan evaporation.. The normal annual precipitation ranges from less than 8 inches for altitudes under 5,000 feet to more than 20 inches above 9,000 feet. The normal annual air temperature ranges from 37 to 47 degrees Fahrenheit and varies inversely with altitude and latitude. The normal annual pan evaporation ranges from 42 to 60 inches and varies directly with normal annual air temperature. Although not mapped, it is shown that the normal April 1 water content of the snowpack increases from about 5 inches at 7,000 feet to about 11 inches at 9,000 feet. In addition, the year-to-year and within-year variances of some climatic characteristics are illustrated. The standard error of estimate when relating normal annual precipitation to altitude is 17%, which is equivalent to the standard error when relating the average for 5 years of observed record at a site to the long-term mean at the site. Thus, it appears that additional observation points would not improve areal coverage unless the observation sites were continued for 5 years or longer. (USGS)
W84-00548

2C. Snow, Ice, and Frost

DOWNWARD WATER MOVEMENT INTO FROZEN GROUND, WESTERN ARCTIC COAST, CANADA,
British Columbia Univ., Vancouver. Dept. of Geography.
J. R. Mackay.
Canadian Journal of Earth Sciences, Vol 20, No 1, p 120-134, 1982. 11 Fig, 1 Tab, 93 Ref.

Descriptors: *Thawing, *Permafrost, *Hydrologic budget, Melting, Frozen ground, Canada, Arctic zone.

Field and laboratory evidence is presented which shows that in summer water can move downwards into the frozen active layer and subjacent permafrost in response to both thermodynamic and gravitational potentials arising during freeze-thaw processes. Direct field evidence discussed includes data from drilling and neutron probe logging, which shows a summer increase in the ice content of the subjacent frozen ground caused by snowmelt infiltration in both permafrost and non-permafrost areas. Conditions which favor the downward migration of water from thawed to frozen ground are examined in terms of thermally induced hydraulic gradients, hydraulic conductivity, content of unfrozen pore water, temperature gradients, ice content, and gravity. Some geocryologic implications of the summer growth of ice in frozen ground include the effects on water balance calculations, the origin of patterned ground, the acceleration of warming of the layer and the top of permafrost, a net downslope frost creep component, and an upward loss in winter at sites where water regularly migrates into the top of the permafrost in summer. (Baker-FRC)
W84-00353

APPLICATIONS SYSTEMS VERIFICATION AND TRANSFER PROJECT, VOL. II, OPERATIONAL APPLICATIONS OF SATELLITE SNOW-COVER OBSERVATIONS AND DATA-COLLECTION SYSTEMS IN THE ARIZONA TEST SITE,
Geological Survey, Phoenix, AZ. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00670

2D. Evaporation and Transpiration

LARGE SCALE DEW COLLECTION AS A SOURCE OF FRESH WATER SUPPLY,

Florida Univ., Gainesville. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 3B.
W84-00469

2E. Streamflow and Runoff

DIURNAL FLUCTUATIONS OF STAGE AND DISCHARGE IN THE DANISH RIVER SUSA,
Danish Land Development Service, Slagelse. Hydrological Survey.
J. Erup.
Nordic Hydrology, Vol 13, No 5, 293-298, 1982. 6 Fig.

Descriptors: *Diurnal distribution, *Water levels, *Rivers, River stages, Fluctuations, Hydrology, Denmark, Susa River, River flow, Unsteady flow.

Distinct and regular diurnal fluctuations of stage and discharge have been observed in the river Susa during dry summer periods. The effects of various factors contributing to the generation of the diurnal fluctuations are discussed in this paper. Most of the area investigated is gently sloping agricultural land consisting of glacial deposits, clay, silt, and gravel. The underground consists mainly of paleocene deposits of chalk and sandstone. The groundwater magazine in the paleocene deposits is artesian in most downstream parts of the river valleys. Along the downstream part of the river there are several grass covered meadows adjoining the river. Some of these riparian zones are waterlogged or very moist, even during dry seasons. The largest regular diurnal fluctuations found usually occur during a short period early each summer. In winter there are no discernible daily fluctuations. Diurnal fluctuations, although of a smaller size, occur further upstream in the main river reach. The time of daily maximum and minimum varies from place to place as well as over the seasons. During periods of precipitation regular diurnal fluctuations are usually absent. (Baker-FRC)
W84-00379

A CLUSTER MODEL FOR FLOOD ANALYSIS,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
J. E. Cervantes, M. L. Kavvas, and J. W. Delleur.
Water Resources Research, Vol 19, No 1, p 209-224, February, 1983. 10 Fig, 3 Tab, 23 Ref.

Descriptors: *Cluster analysis, *Flood peak, *Hydrographs, Model studies, Runoff, Precipitation, Ohio River, Flood forecasting, Stochastic process.

Flood peaks of a hydrograph were modeled by a two-level and two-dimensional nonhomogeneous point stochastic process. It is a cluster process of the Neyman-Scott type and gives the occurrences of flood generating mechanisms (FGM) at the precipitation level as the triggers for clusters of flood peaks at the runoff level. The FGMs are studied in terms of their times of occurence and their volumes. The volume of a FGM corresponds to the volume of precipitation in the precipitation cluster that originates at the occurrence time of the FGM. Each precipitation cluster at the precipitation level is represented by its origin time and by its volume as a point in a time-volume plane. The FGM points in the time-volume plane of the precipitation level form a two-dimensional process with a non-homogeneous rate of occurence. A two-dimensional subsidiary process is generated at the runoff level. This process represents the occurrences of flood peaks as a point in the time magnitude plane determined by the conditional rate of occurrence. The statistical properties of the flood cluster process (number of flood peaks) are found in terms of the probability generating functional of the process. Two two-dimensional parameters are estimated. Comparison of the rate of occurrence, covariance density, and probability mass function obtained from calculations and from data from several stations in the Ohio River Basin produced good agreement. (Cassar-FRC)
W84-00395

RAYLEIGH-JEFFREYS STABILITY OF THERMOHALINE STRATIFIED FLUIDS SUBJECT TO VERTICAL FLOWS,
Technion - Israel Inst. of Tech., Haifa. Energy Engineering Center.
For primary bibliographic entry see Field 3A.
W84-00462

SIMULATED STREAMFLOW DATA FOR NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
E. H. Wiser.
UNC-WRRI Rpt. No 170, December 1981. 41 p, 3 Fig, 6 Ref, 11 Append. OWRT A-093-NC(1), 14-34-0001-7070.

Descriptors: *Streamflow forecasting, Simulation analysis, Simulation, Streamflow, *Water data, Mean flow, Low flow, High flow, Watersheds, *North Carolina, Synthesis, Reservoir regulation.

A system was developed for simulation of streamflow data at any point in a region. The system is know as NCSSARR(North Carolina version of the Streamflow Synthesis and Reservoir Regulation model). NCSSARR is based on the Streamflow Synthesis and Reservoir Regulation (SSARR) Program developed at the North Pacific Division of the Corps of Engineers in Portland, Oregon. Control programming minimizes input requirements to permit a planner with limited hydrologic or computer background to use the system. The system is interfaced with the data storage and retrieval system known as HISARS to provide convenient data access as well as routine processing of the simulated streamflow data. Simulated streamflow data have been obtained for most river basins in North Carolina. Parameters required for the simulation have been obtained by comparing the simulated data with observed data wherever available. After fitting, the simulated data have been compared with observed data with respect to several criteria, including mean flow, low flow, high flow and monthly distribution. The data are in reasonable agreement for most stream gages, implying that the simulated data may be used in lieu of observation wherever the latter are not available.
W84-00492

LINEAR THEORY OF SUBSURFACE STORM FLOW,
Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering.
A. D. Koussis, and L. -T. Lien.
Water Resources Research, Vol 18, No 6, p 1738-1740, December, 1982. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Mathematical equations, *Streamflow, *Kinematic wave theory, *Mathematical studies, *Hydrographs, *Storm seepage, Mathematical models, Storm runoff, Surface runoff, Surface flow, Subsurface drainage, Infiltration, Permeability coefficient.

A solution to the subsurface storm flow problem, a special case of the interflow problem connected to streamflow, is developed through linearization of the complete one-dimensional governing equation. Water surface profiles and outflow hydrographs obtained from this mathematical approximation are compared with the exact solution and with the kinematic approximation to this problem for cases in which subsurface storm flow is equated to four times the product of the constant infiltration intensity and the cosine of the bedrock inclination divided by the product of the hydraulic conductivity and the square of the sine of the bedrock inclination. The accuracy and range of applicability of the proposed theory are greater than that of the kinematic theory, and its results are considered satisfactory for cases where the subsurface storm flow is greater than or equal to 0.25 and less than or equal to 1. (Geiger-FRC)
W84-00517

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE LAKE MICHIGAN BASIN, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
B. K. Holmstrom.
USGS Open-File Report 81-1193 (WRI), March 1982. 102 p, 7 Fig, 2 Plates, 3 Tab, 18 Ref.

Descriptors: *Low flow, *Streamflow, *Streamflow forecasting, *Regression analysis, Low-flow frequency, Equations, Baseflow, Evaluation, Flow characteristics, Flow duration, Flow rates, *Wisconsin, Lake Michigan basin.

Low-flow characteristics of streams in the Lake Michigan basin are presented. Included are estimates of low-flow frequency at 30 gaging stations, flow duration at 13 gaging stations, and selected low-flow frequency characteristics at 22 low-flow partial-record stations and 123 miscellaneous sites. Equations are provided to estimate low-flow characteristics at sites where one base-flow discharge measurement is available. The equations were determined from multiple-regression analyses that related low-flow characteristics at gaging stations and low-flow partial-record stations to basin characteristics. Drainage area and base-flow index were the most significant characteristics in explaining the variation in low flow for sites where one low base-flow measurement (flow durations greater than 80%) has been made. The equations and corresponding standard errors of estimate are computed. Low-flow characteristics are not well defined in the Lake Michigan basin. Standard errors for low-flow characteristics at gaging stations, low-flow partial-record stations, and miscellaneous sites are much higher than State averages. The standard errors for the regression equations are also very high. This is due in part to the flow of many streams in the basin approaching 0 ft/s during low base-flow periods. The graphical regression relation lines are steep for stations on these streams and the resulting standard errors are relatively high. (USGS).
W84-00546

THE INHERENT ASYMMETRY OF RIVER MEANDER PLANFORM,
McGill Univ., Montreal (Quebec). Dept. of Geography.
M. A. Carson, and M. F. Lapointe.
Journal of Geology, Vol 91, No 1, p 41-55, 1983. 15 Fig, 3 Tab, 38 Ref.

Descriptors: *Meanders, *Rivers, *Geomorphology, River flow, Symmetry, Asymmetry.

Evidence is presented to demonstrate that most meander loops are asymmetrical and, more important, that the nature of this asymmetry is not random, but well-defined and consistent. That preferred asymmetry should exist in meander loops does not appear to be the result of chance but seems to reflect certain inherent features of flow through bends. Two forms of asymmetry indicative of flow direction are often displayed. One is downchannel delay in the inflection point of meanders, producing traverses which are dominantly convex facing downvalley. The other is upvalley skew in the axis of gooseneck loops. An index of inflection asymmetry is presented and applied to 15 rivers; the data confirm the statistical preference for delayed inflection. An explanation of the phenomenon is offered based on the hydraulics of flow through bends. Of major importance appears to be the persistence downchannel of patterns of helical circulation and the cross-sectional distribution of longitudinal velocity well past the bend that forms them. The upvalley skew of goosenecks is, in many cases, nothing more than an extreme form of convex-downvalley looping, maintained as meanders have increased their tortuosity. Some goosenecks, however, show no delayed inflection and appear to develop from differences in rates of downvalley migration between adjacent meander traverses. It is concluded that the minimum variance theory and the sine-generated model of meanders should now be discarded. (Baker-FRC)
W84-00568

INDEX OF SURFACE-WATER STATIONS IN TEXAS, JANUARY 1982,
Geological Survey, Austin, TX. Water Resources Div.

For primary bibliographic entry see Field 7A.
W84-00643

TIME OF TRAVEL OF THE FLINT RIVER, UTAH DAM TO HIGHWAY M-13, MICHIGAN: AUGUST 4-8, 1981,
Geological Survey, Lansing, MI. Water Resources Div.
T. R. Cummings, and J. B. Miller.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $3.50 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-853, August 1982. 21 p, 12 Fig, 4 Tab.

Descriptors: *Dye releases, *Tracers, *Dispersion, Mixing, *Water pollution sources, *Waste assimilative capacity, Waste dilution, Waste disposal, Flint River, Genesse County, *Michigan.

The tracing of Rhodamine WT dye has provided time-of-travel data for waste-load allocation studies of a 42.8-mile reach of the Flint River at low flow. Dye was injected at two locations in Flint--at Utah Dam and at Grand Traverse Street. From Utah Dam to Grand Traverse Street the mean velocity of flow was 0.1 foot per second; time-of-travel was 35.3 hours. From Grand Traverse Street to Highway M-13, mean velocity was 0.7 foot per second; time-of-travel was 78.8 hours. Time-of-travel for the reach between Utah Dam and Highway M-13 was thus 114 hours. A discharge of equaled or exceeded about 90% of the time was measured at Grand Traverse Street in Flint before dye injection. (USGS)
W84-00647

MAGNITUDE AND FREQUENCY OF FLOODS IN EASTERN OREGON,
Geological Survey, Portland, OR. Water Resources Div.
D. D. Harris, and L. E. Hubbard.
USGS Water Resources Investigations Report 82-4078, 1983. 39 p, 7 Fig, 4 Tab, 39 Ref.

Descriptors: *Flood frequency, *Peak discharge, Natural flow, Flood forecasting, Analytical techniques, *Oregon, Log Pearson type III.

A method for estimating the magnitude and frequency of floods is presented for unregulated streams in eastern Oregon. Equations relating flood magnitude to basin characteristics were developed for exceedance probabilities of 0.5 to 0.01 (2- to 100-year recurrence intervals). Separate equations are presented for four regions: Southeast, Northeast, North Central, and Eastern Cascades. Also presented are values of flood discharges for selected exceedance probabilities and of basin characteristics for all gaging stations used in the analysis. Included are data for 148 stations in Oregon, 3 stations in northern California, 3 stations in western Idaho, 4 stations in northern Nevada, and 4 stations in southern Washington. Drainage areas used in the analysis range from 0.47 to 11,300 square miles. Also included are maximum discharges for all eastern Oregon stations used in the analysis. (USGS)
W84-00657

FLOODS FROM SMALL DRAINAGE AREAS IN ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00659

2F. Groundwater

DISCUSSION: ASPECTS OF HYDROLOGY IN THE PROVINCE OF NORTH SUMATRA, INDONESIA,
For primary bibliographic entry see Field 2A.
W84-00351

OUTLINES OF THE HYDROGEOLOGICAL CONDITIONS IN THE SUSA-AREA, DENMARK,
Danmarks Geologiske Undersoegelse, Copenhagen.
N. Kelstrup, and K. Binzer.
Nordic Hydrology, Vol 13, No 5, p 279-292, 1982. 5 Fig, 10 Ref.

Descriptors: *Aquifers, *Groundwater recharge, Percolation, Limestone, Greensand, Sand, Lithology, Quaternary deposits, Hydrology, Infiltration, Denmark, Susa catchment.

Archive data and borehole logging were used to study a pre-Quaternarygreensand limestone aquifer at Susa, Denmark. The aquifer was composed of layers of different lithology, i.e., clay marl, lime sand, limestone and hardgrounds, which dip slightly toward the northwest and are cut by faults. The fault zones, together with a fracture system in the top layers of the aquifer caused by ice pressure, localize zones of high hydraulic conductivity. The hydraulic negative boundaries are found in zones of low hydraulic conductivity mainly within the fault blocks. Both the hydraulic gradient and the hydraulic conductivity decrease with depth in the aquifer. The main part of the groundwater flow is thus taking place at the upper part of the aquifer. The hydrogeology of the Quaternary acquifers was studied by means of environmental tritium levels. Depth of penetration of the tritium was found and hydraulic properties such as actual velocity, hydraulic conductivity and leakage factors have been estimated. Point values of infiltration are given for the two localities at 100-150 mm/year. The groundwater recharge to the limestone aquifers underlying the Quaternary deposits are estimated at between 55-105 mm/year. The distribution of the two lithological types is important for determining areas with downward percolation and areas where a hydrological circuit in the upper layers reduces downward percolation. (Baker-FRC)
W84-00373

A DISTRIBUTED GROUNDWATER/SURFACE WATER MODEL FOR THE SUSA-CATCHMENT. PART II - SIMULATIONS OF STREAMFLOW DEPLETIONS DUE TO GROUNDWATER ABSTRACTION,
Technical Univ. of Denmark, Lyngby.
J. C. Refsgaard, and E. Hansen.
Nordic Hydrology, Vol 13, No 5, p 311-322, 1982. 5 Fig, 1 Tab, 2 Ref.

Descriptors: *Aquifer recharge, *Groundwater, *Model studies, Susa catchment, Catchment areas, Denmark, Groundwater abstraction, Confined acquifers, Streamflow.

The distributed groundwater/surface water model as presented has been successfully tested on historical streamflow data from the Koge A catchment, which is heavily influenced by a groundwater abstraction. The physical mechanisms of streamflow depletion due to groundwater abstraction in catchments where a confined acquifer is overlaid by Quaternary drift deposits have been discussed and illustrated by some simulation results. The large scale effects of a groundwater abstraction on the recharge and steamflow are illustrated. The relative streamflow depletion has been shown to vary considerably from one catchment to another and to depend heavily on the size of the groundwater abstraction. Consequently it is not possible to assign a general streamflow depletion curve, neither to the entire Susa area nor to the individual sub-catchments. For confined acquifers it was found that the location of pumping wells in practice has negligible influence on the streamflow depletion. (Baker-FRC)
W84-00377

A DISTRIBUTED GROUNDWATER/SURFACE WATER MODEL FOR THE SUSA-CATCHMENT, PART I - MODEL DESCRIPTION,
Technical Univ. of Denmark, Lyngby.
J. C. Refsgaard, and E. Hansen.
Nordic Hydrology, Vol 13, No 5, p 299-310, 1982. 8 Fig, 12 Ref.

Descriptors: *Model studies, *Groundwater recharge, Catchment areas, Susa-catchment, Denmark, Evapotranspiration, Streamflow, Hydrology, Aquifers.

A distributed hydrological model has been developed for the Susa catchment, covering about 1,000 sq km of Zealand, Denmark. The landscape is a moraine type formed by glaciers during the last glacial period. The pre-Quaternary aquifer consists of Paleocene deposits and Danian limestone. It is overlayered by glacial deposits, predominantly consisting of moraine clay, yet with some few areas with sandy soil. The model gives a physically based description of the main processes in the entire land phase of the hydrological cycle. The model simulates seasonal as well as year-to-year variations in the hydrological regime of the catchment as a consequence of changing hydro-meteorological and climatological conditions as well as of the influence of man. Almost all the model parameters are physical parameters such as transmissivities, storage coefficients, topographical data, field capacity, and leaf area index. The model has a general applicability in areas with similar hydrogeological conditions. This would be the case for a low confined aquifer with relatively large transmissivities overlayered by low permeable saturated deposits and the phreatic surface rather close to terrain. Calibrations and test simulations have been presented for the Susa catchment with respect to hydraulic heads of the confined aquifer, streamflow and soil moisture. Seasonal and year-to-year variations in the hydrological regime have been considered. (Baker-FRC)
W84-00378

LONG-TERM VARIATIONS OF GROUNDWATER RESOURCES OF THE NORTHERN HEMISPHERE,
R. K. Klige, and V. S. Kovalevskii.
Water Resources (English Translation), Vol 9, No 3, p 263-271, May-June, 1982. 6 Fig, 1 Tab, 23 Ref. Translated from Vodnye Resursy, No 3, p 57-66, May-June, 1982.

Descriptors: *Groundwater management, *Water resources development, *Climatology, USSR, United States, Runoff, Rivers, Water supply, Water demand, Forecasting, Mathematical equations, Water levels.

The long-term trend of recharge of groundwater resources was studied using data from chronological runoff series occurring mainly during the winter low-water period at which time rivers are fed primarily by groundwaters. The data were collected from more than 1000 gauging stations over 15-80 years, with the bulk of the series having a duration of 25-40 years. As a result of the study a complex equation was ultimately derived for calculating variations of the groundwater level and the deviations from them of the mean long term value during 1929-1970, taking into account both climatic changes and the anthropogenic effect expressed in world water consumption. At present long-term variations of groundwater resources are related 80-90% to climatic factors. The equation permits reconstruction of the variation of the groundwater levels during the period for which there are data on the basis of the parameters figuring in it from 1893-1975 and even forecasting their variation within 12 years, 1976-1987, with consideration of the lag time. The noted general trends of the long-term variation of groundwater resources agree well with a number of other natural processes such as the retreat of glaciers and shoaling of closed lakes and the increase of the level of the World Ocean as well as the decrease of land water supplies and the analogous increase of water supplies in the ocean. It is concluded that, if the current climatic conditions stay the same, a further decrease of groundwater resources is possible. This process can be intensified considerably during warming of the climate under the effect of further anthropogenic influences on it. (Baker-FRC)
W84-00380

RECHARGE FROM AN EPHEMERAL STREAM FOLLOWING WETTING FRONT ARRIVAL TO WATER TABLE,
Ministry of Agriculture and Water, Riyadh (Saudi Arabia).
M. J. Abdulrazzak, and H. J. Morel-Seytoux.

Water Resources Research, Vol 19, No 1, p 194-200, February, 1983. 7 Fig, 33 Ref.

Descriptors: *Ephemeral streams, *Recharge, *Arid lands, Wetting, Infiltration, Groundwater recharge, Aquifers, Water table, Groundwater mound.

After the infiltration wetting front from a river bed of an ephemeral stream in flood reaches the shallow water table, the rate of recharge, which is also that of infiltration, is affected by the development of a groundwater mound. The effect is practically immediate if the water content behind the wetting front is close to saturation. An approximate analytical solution is developed in that case, which predicts the time dependence of the recharge rate. Comparison with experimental results in th laboratory shows that the solution is excellent in spite of the assumptions necessary in the derivations. As long as the ratio of river width over depth to water table exceeds 2 and as long as the ratio of initial saturated thickness over depth to the water table exceeds 2.5, the analytical solution is essentially exact. Under most field conditions these ratios are largely exceeded. Consequently, the predictive equation for the time dependence of the recharge is both quite simple to use and adequately accurate for field applications. (Author abstract)
W84-00390

FLOW TOWARD STORAGE TUNNELS BENEATH A WATER TABLE 1. TWO-DIMENSIONAL FLOW,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
A. Tal, and G. Dagan.
Water Resources Research, Vol 19, No 1, p 241-249, February, 1983. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Water table profiles, *Tunnel hydraulics, *Underground storage, Storage gallery, Excavation, Groundwater movement, Unsteady flow, Cavern flow.

A computer program was developed for the two-dimensional unsteady flow of water beneath a water table toward parallel tunnel-shaped caverns excavated in saturated rock of low permeability for the purpose of storing oil or LPG. A numerical scheme, based on the boundary integral elements method, was used to determine the water table motion, the inflow to the galleries, and the velocity on the perimeter. Both oil-filled and air-filled caverns were considered. While the shape of the galleries was constant, the spacing between them and the distance to an impervious bottom were varied. Numerical results permitted calculation of the time required for the water table to drop from its initial position to the gallery top or to the product level, the water velocity on the gallery perimeter, and the total inflow to the gallery. The dimensionless velocity of descent of the water table above and near the top of the cavern was practically constant and insensitive to geometry. The dimensionless time required for the free surface to drop from the cavern top to the height near that of the oil level was also practically constant. The influence of the horizontal impervious boundary was negligible. (Cassar-FRC)
W84-00396

EXPERIMENTAL INVESTIGATION ON IRREVERSIBLE CHANGES OF HYDRAULIC CONDUCTIVITY ON THE SEAWATER-FRESHWATER INTERFACE IN COASTAL AQUIFERS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
L. C. Goldenberg, M. Magaritz, and S. Mandel.
Water Resources Research, Vol 19, No 1, p 77-85, February, 1983. 5 Fig, 4 Tab, 46 Ref.

Descriptors: *Saline-freshwater interfaces, *Hydraulic conductivity, *Coastal aquifers, Saline water intrusion, Aquifer properties, Clays, Permeability, Fate of pollutants.

Changes in hydraulic conductivity of Israeli coastal sediments (<5% clay) produced by flushing with seawater followed by fresh water were studied in laboratory columns. Hydraulic conductivities decreased by a maximum of 0.1 to 0.001 of the original values whenever seawater was flushed from the soil by fresh groundwater. Subsequent flushing with seawater did not significantly restore the original hydraulic conductivities. Using synthetic waters with CaC12 and NaCl at the same ionic strengths as the natural waters showed that the decrease in hydraulic conductivity was caused by an incipient stage of gel formation. The small water-clay bodies closed the spaces between pores. Results show that a shift of the seawater-fresh water interface in an aquifer containing even a small percentage of clays can create a relatively permanent, almost impermeable boundary in the region of the interface. Attempts to change this interface position by injecting fresh water would likely produce an impermeable boundary within a short time. (Cassar-FRC)
W84-00403

THREE-DIMENSIONAL STOCHASTIC ANALYSIS OF MACRODISPERSION IN AQUIFERS,
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 5B.
W84-00408

REPORT ON GROUND WATER DEPENDENCE IN NEW YORK STATE.
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
1981. 47 p, 2 Fig, 3 Tab, 1 Append.

Descriptors: *Groundwater availability, *Groundwater depletion, *Groundwater storage, *Aquifers, *Aquifer systems, Available water, Groundwater basins, Aquifer management, Water supply, Water use, Water users, Aqueducts, *New York.

Recently, attention has focused on averting the possible degredation of New York State's groundwater resources. Toward this end, it must be determined which areas use groundwater as a significant source of portable water, and where the major aquifers are located. This report describes the groudwater use of three geographic areas of New York State: Long Island, New York City and upstate New York. On Long Island, the population of the counties of Nassau and Suffolk are 99.88% dependent on groundwater, while New York depends for the most part on surface water for its supply. The New York City aqueduct system supplies 93% of the population. In upstate New York, the availability of groundwater as a source of drinking water varies widely from area to area. Approximately 36% of the upstate population of 7,880,000 uses groundwater as their source of drinking water. The eighteen primary aquifers in New York State are in unconsolidated sand and gravel deposits. To determine their locations, source and treatment, files were searched for groundwater supplies serving populations of 8,000-10,000 or for supplies serving smaller populations of 5,000-6,000 with both surface and groundwater usage. These records were then used in conjunction with USGS reports and county water supply maps. (Garrison-Omniplan)
W84-00499

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE BLOCKER AREA, PITTSBURG COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
M. V. Marcher, D. L. Bergman, J. D. Stoner, and S. P. Blumer.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $12.00 in paper copy, $5.00 in microfiche. USGS Open-File Report 81-1187 (WRI), 1981. 48 p, 9 Fig, 14 Tab, 13 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Groundwater movement, Groundwater recharge, Wells, Water level, Streams, Rocks, Strip mining, Chemical analysis, *Oklahoma, Pittsburg County, Blocker.

Bedrock in the Blocker area of southeastern Oklahoma consists principally of shale, siltstone, and sandstone of the Boggy and Savanna Formations of Pennsylvanian age. These rocks have been folded to form the Panther Mountain syncline on the south and the Kinta anticline on the north. Alluvium along streams is less than 15 feet thick and consists mainly of sandy silt. Water in bedrock is under artesian conditions. Well depths range from 11 to 213 feet and average 75 feet. In 86% of the wells measured, the water level was less than 30 feet below the land surface. Because the rocks have minimal permeability, well yields probably are less than 5 gallons per minute. Ground water is commonly a mixed cation bicarbonate type with dissolved solids ranging from about 300 to 2,000 milligrams per liter. No relationship between water chemistry and well depth or geographic distribution is apparent. Streams in the area are ephemeral and there are extended periods of no flow. Blue Creek was dry 30% of the time during 1976-80 and had flows of less than 0.1 cubic foot per second for at least 80 consecutive days. Stream water is generally a mixed cation sulfate type. The maximum dissolved-solids concentration determined in stream water was 3670 milligrams per liter. Maximum suspended sediment discharge, in tons per day, was about 235 for Blue Creek, 40 for Blue Creek tributary, and 630 for Mathuldy Creek. Silt-clay particles (diameters less than 0.062 millimeter) are the dominant sediment size. Surface mining for coal undoubtedly will have some effect on the environment. The most likely deleterious effects are increased sediment loads in streams and increased mineralization of stream waters. However, these effects should be of only limited extent and duration if appropriate mining and reclamation practices are followed. (USGS)
W84-00540

WATER RESOURCES OF THE GIG HARBOR PENINSULA AND ADJACENT AREAS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00544

HYDROLOGIC DATA FOR THE POTOMAC FORMATION IN NEW CASTLE COUNTY, DELAWARE,
Geological Survey, Dover, DE. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00545

EFFECTS OF UNDERGROUND MINING AND MINE COLLAPSE ON THE HYDROLOGY OF SELECTED BASINS IN WEST VIRGINIA,
West Virginia Geological and Economic Survey, Morgantown.
W. A. Hobba, Jr.
West Virginia Geologic and Economic Survey Report of Investigation RI-33, 1981. 77 p, 57 Fig, 3 Tab, 24 Ref.

Descriptors: *Base flow, *Subsidence, *Mine drainage, *Surface-groundwater relations, Geologic fractures, Permeability, Water table, Observation wells, Runoff, Hydrologic budget, *West Virginia.

The effects of underground mining and mine collapse on the hydrology of an area where the mined bed of coal lies above major streams, and in another area where the bed of coal lies below major streams, are described. Subsidence cracks at land surface generally parallel predominant joint sets in the rocks. The mining and subsidence cracks cause increased infiltration of precipitation and surface water, decreased evapotranspiration, and higher base flows in some small streams. Groundwater levels in observation wells in under-mined areas fluctuate as much as 100 feet annually. Both gaining and loosing streams are found in under-mined areas. Mine pumpage and drainage generally cause diversion of water underground from one basin to another. Areal and single-well aquifer tests indicated near-surface rocks have higher transmissivity values in a mine-subsided basin than in unmined basins. Increased infiltration and circulation through near-surface rocks increases dissolved

mineral loads in streams, as do treated and untreated contributions from mine pumpage and drainage. Abandoned and flooded underground mines make good reservoirs because of their increased transmissivity and storage. Subsidence cracks were not successfully detected by thermal imagery, but springs and seeps were detected and mapped. (USGS)
W84-00547

GEOHYDROLOGY OF PRINCIPAL AQUIFERS IN THE REPUBLICAN RIVER BASIN, KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00549

POSITION OF THE SALTWATER-FRESHWATER INTERFACE IN THE UPPER PART OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA, 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00550

THICKNESS OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00551

TOTAL HARDNESS OF WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00595

SULFATE CONCENTRATION IN WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00596

THICKNESS OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00597

GEOLOGY AND CONFIGURATION OF THE BASE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00598

CONFIGURATION OF THE BASE OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00599

GEOLOGY AND CONFIGURATION OF THE TOP OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00600

HYDROLOGY OF THE FLORIDIAN AQUIFER IN NORTHWEST VOLUSIA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
A. T. Rutledge.
USGS Water-Resources Investigations, Open-File Report 82-108, 1982, 165 p, 51 Fig, 1 Map, 10 Tab, 13 Ref.

Descriptors: *Aquifer, Recharge, Discharge, Irrigation, *Irrigation wells, *Drawdown, Sinkholes, Flow-net analysis, Water budget, Saltwater intrusion, Aquifer testing, *Florida, Northwest Volusia County, *Floridan aquifer.

The characteristics of the Floridan aquifer in northwest Volusia County and the effects of fernery irrigation withdrawals from the Floridan aquifer were studied. The large irrigational withdrawals, especially in winter months when spray irrigation is used for freeze protection, introduce problems such as the potential for saltwater intrusion, the temporary loss of water in domestic wells caused by large potentiometric drawdown, and increased sinkhole activity. Average ground-water irrigational withdrawal is 8.1 million gallons per day while peak withdrawal rate is 300 million gallons per day during freeze-protection pumpage. Transmissivities of the Floridan aquifer range from 4,500 to 163,000 feet squared per day. Highest transmissivities are in the DeLeon Springs area and the lowest are in the east Pierson area. The drawdown in the Pierson area at the end of one intense pumpage exceeded 30 feet over a 4.4 square mile area. A significant amount of the withdrawn water was replaced by leakage during the pumping period. No long-term residual drawdown has occurred. Sinkhole activity has been increased by the temporary increase in load on the aquifer's skeletal structure during intense potentiometric drawdowns. There is no evidence of saltwater intrusion, but a monitoring network for future early detection is suggested. (USGS)
W84-00601

COMPILATION OF SELECTED GROUND-WATER-QUALITY DATA FROM THE SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00604

GROUND-WATER DATA FOR SELECTED COAL AREAS IN WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00606

GROUND WATER RESOURCES OF THE GLACIAL-OUTWASH ALONG THE WHITE RIVER, JOHNSON AND MORGAN COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4B.
W84-00609

AVAILABILITY AND QUALITY OF WATER FROM THE DAKOTA AQUIFER, NORTHWEST IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00611

GROUND-WATER RESOURCES IN THE HOOD BASIN, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
S. J. Grady.
USGS WRI/Open-File Report 81-1108, 1983. 68 p, 12 Fig, 2 Tab, 2 Maps, 25 Ref.

Descriptors: *Aquifers, *Groundwater, *Basalts, Confined water, Observation wells, *Potentiometric levels, Geology, *Overdraft, Specific capacity, Hydrologic properties, Storage coefficient, Wells, Water quality, *Oregon, Columbia River, Hood Basin, Cascade Range.

The Hood Basin in north-central Oregon consists of about a 1,035-square-mile area underlain by Miocene to Holocene age volcanic, volcaniclastic, sedimentary rocks, and unconsolidated surficial deposits. The most important aquifer is the Columbia River Basalt Group, a unit that underlies most of the basin and probably exceeds a thickness of 2,000 feet wherever it is present. By 1980, only the upper 1,000 feet or less of the formation has been developed for water supplies. Most of this development is in the semiarid eastern half of the basin. Wells in the aquifer unit generally yield from 15 to 1,000 gallons per minute and a few yield as much as 3,300 gallons per minute. Other aquifer units in the basin have more limited areal extent and smaller saturated thickness than does the Columbia River Basalt Group. Generally, these units are capable of yielding from a few to a few hundred gallons per minute to wells. Most of the ground water in the basin is chemically suitable for domestic, irrigation, or other uses. Some ground water has objectionable concentrations of iron (0.3 to 6.4 mg/l) and manganese (0.05 to 1.2 mg/l) or is moderately hard to very hard (60 to 260 mg/l) as calcium carbonate. (USGS)
W84-00613

GROUND-WATER PUMPAGE IN NASSAU COUNTY, LONG ISLAND, NEW YORK, 1920-77, INTRODUCTION AND USER'S GUIDE TO THE DATA COMPILATION,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00614

GROUND-WATER DATA FOR GEORGIA, 1980,
Geological Survey, Doraville, GA. Water Resources Div.
S. E. Matthews, W. G. Hester, and M. P. O'Byrne.
USGS Open-File Report 81-1068, 1981. 94 p, 48 Fig, 24 Ref.

Descriptors: *Groundwater, *Water levels, Aquifers, *Georgia, Water quality, *Groundwater levels, Groundwater quality.

More than 2,000 water-level measurements made in Georgia in 1980 provided the basic data for this report. Daily mean water-level fluctuations and trends are shown in hydrographs for the previous year and fluctuations of the monthly mean water level are shown for the previous 10 years in selected observation wells in Georgia. Monitoring ground-water levels is essential to the understanding of storage changes in a ground-water reservoir or aquifer. Fluctuations and long-term trends in water levels occur as a result of recharge to and discharge from the reservoir. Mean annual water levels across Georgia were from 1.92 feet higher to 12.61 feet lower in 1980 than in 1979, and in some areas were the lowest on record. (USGS)
W84-00615

FAULT SEVERING OF AQUIFERS AND OTHER GEOLOGICALLY CONTROLLED PERMEABILITY CONTRASTS IN THE BASIN-MOUNTAIN INTERFACE, AND THE IMPLICATIONS FOR GROUND WATER RECHARGE TO AND DEVELOPMENT FROM THE MAJOR ARTESIAN BASINS OF WYOMING,
Wyoming Univ., Laramie. Dept. of Geology and Geophysics.
P. W. Huntoon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132497, Price codes: A04 in paper copy, A01 in microfiche.

Water Research Center Completion Report, June 1983. 67 p, 14 Fig, 3 Tab, 45 Ref. OWRT A-034-WYO(1), 14-34-0001-2154.

Descriptors: *Groundwater recharge, Geohydrology, Geologic fractures, Cavitation, Permeability, Artesian basins, *Aquifers, Paleozoic aquifers, *Fault severing, *Wyoming, Foreland basin, Laramide thrust faults.

The recharge areas for the major Paleozoic aquifers in the Wyoming foreland basins fall into three broad classes ranked from least to most efficient in hydraulic interconnection with the aquifers in the basins: (1) fault severed, (2) continuous homoclines, and (3) obliquely faulted. The fault severed and continuous homoclines classes each encompass slightly less than half the basin perimeters thus making these types very common. Recharge to the deep basins is precluded along the fault severed boundaries. Consequently independent circulation systems develop in the hanging wall blocks mountainward from the basin perimeter. Most of the recharge water which enters the recharge areas along the homoclinal margins is rejected from the aquifer before entering the deep parts of the basin. This results because the diagenetic processes of recrystallization, cementation, and compaction have operated to reduce or destroy permeability basinward from the recharge areas since the recharge areas became differentiated from the basin proper. In both the fault severed and homoclinal margin cases, recharge along the basin perimeters is precluded or diminished over permeabilities determined for the aquifers from the recharge areas. The consequences of this finding are twofold: (1) development of ground water from the Paleozoic rocks in the interior parts of the extensive Wyoming artesian basins is largely unfavorable, and (2) developers are forced to limit their search for the best prospects to the recharge zones along the perimeters of the basins. The immediate result is: (1) the target drilling areas are dramatically reduced to a small percentage of the basin surfaces, and (2) development in the recharge areas interferes with existing surface water rights.
W84-00636

GEOHYDROLOGY AND EFFECTS OF WATER USE IN THE BLACK MESA AREA, NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
J. H. Eychaner.
USGS Open-File Report 81-911, July 1981. 66 p, 12 Fig, 3 Tab, 25 Ref.

Descriptors: *Groundwater, *Aquifers, *Aquifer characteristics, *Hydrologic budget, *Computer models, Indian reservations, Arid lands, Observation wells, Coal mines, Slurries, Planning, *Arizona, Navajo Sandstone, Navajo Indian Reservation, Hopi Indian Reservation, Black Mesa area.

The main source of water in the 5,400-square-mile Black Mesa area is the N aquifer, which consists of the Navajo Sandstone and underlying Kayenta Formation and Wingate Sandstone. Water is under confined conditions in the central 3,300 square miles. Transmissivity is less than 1,000 feet squared per day. Storage coefficient is less than 0.0004 in the confined part of the aquifer and at least 0.1 in the unconfined part. Recharge is about 13,000 acre-feet per year, and storage at equilibrium, which was before 1965, was at least 180 million acre-feet. Ground-water withdrawals were less than 400 acre-feet per year before 1970 and increased to 5,300 acre-feet per year 1976-1979. By 1980, municipal-supply pumpage is expected to exceed that for a coal-slurry pipeline. Water levels have declined throughout the confined part of the aquifer. Decline of more than 100 feet was calculated for an area of 200 square miles through 1979 and was projected for 440 square miles through 2001. In the unconfined part, project declines averaged less than 1 foot. If pumping for coal slurry stopped, most of the decline would recover within 10 years. (USGS)
W84-00642

WATER RESOURCES OF THE BLACK HAND SANDSTONE MEMBER OF THE CUYAHOGA FORMATION AND ASSOCIATED AQUIFERS OF MISSISSIPPIAN AGE IN SOUTHEASTERN OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
S. E. Norris, and G. C. Mayer.
USGS Open-File Report 82-170, 1982. 95 p, 18 Fig, 3 Tab, 17 Ref.

Descriptors: Hydrogeology, *Aquifer characteristics, Water resources, Groundwater movement, Specific capacity, Transmissivity, *Ohio, Coal hydrology, Black Hand Sandstone Member of the Cuyohoga Formation.

The Black Hand Sandstone Member of the Cuyahoga Formation and associated acquifers of Mississippian age, including the Allensville Conglomerate Member of the Logan Formation, (both members of the local usage) were investigated in a 1,500-square-mile area in southeastern Ohio. These aquifers are the chief sources of water beneath the coal-bearing rocks of the Pennsylvanian System and are widely use for farm and home requirements. The aquifers crop out in the western part of the area and dip southeastward 35 feet per mile. At Lake Hope, in northeastern Vinton County, the aquifers are the deepest sources of ground water in Ohio, occurring at depths locally exceeding 700 feet. At McArthur, in Vinton County, the aquifers yield about 300,000 gallons per day for municipal and industrial use, but withdrawal has been accompanied by declining ground-water levels during the past 10 years in a 10-square-mile area. (USGS)
W84-00644

WATER RESOURCES OF THE ZUNI TRIBAL LANDS, MCKINLEY AND CIBOLA COUNTIES, NEW MEXICO,
Geological Survey, Albuquerque, NM. Water Resources Div.
B. R. Orr.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $26.00 in paper copy, $4.00 in microfiche. USGS Open-File Report 82-1013, 1982. 173 p, 25 Fig, 5 Tab, 34 Ref.

Descriptors: *Groundwater resources, *New Mexico, *Aquifer characteristics, *Water wells, Water quality, Springs, Hydrogeology, *Zuni Indian Reservation, Zuni Mountains, McKinley County, Cibola County, Well and spring inventory.

The sandstones and limestones of the Glorieta-San Andres aquifer and sandstones within the Chinle Formation provide most of the municipal, stock, and domestic water supply to the Zuni Indian Tribe in west-central New Mexico. Both aquifers are recharged at outcrops in the Zuni Mountains, and their hydraulic conductivity is significantly enhanced by fractures in the sandstones and by fracture-solution openings in the carbonate rocks. The range of well yields, from 5 to 150 gallons per minute, is attributed to fracture frequency, continuity, and distribution controlled by regional uplift and folding. Water in the Glorieta-San Andres aquifer is enriched in calcium and sulfate, and dissolved-solids concentrations range from 389 to 994 milligrams per liter. Water in the sandstones of the Chinle Formation is enriched in sodium and bicarbonate, and dissolved-solids concentrations range from 215 to 1,980 milligrams per liter. The Bidahochi Formation, a loosely consolidated sand and gravel unit mantling western parts of the reservation, could provide an additional source of water chemically suitable for most uses. Preliminary seismic-reflection studies showed a buried drainage system eroded in Triassic bedrock underlying the Bidahochi. Filled channels may contain sufficient saturated material to supplement existing water supplies. (USGS)
W84-00646

GROUND-WATER APPRAISAL OF THE PINE BUSH AREA, ALBANY COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
D. S. Snavely.
USGS Water-Resources Investigations Report 82-4000, 1983. 64 p, 11 Fig, 8 Tab, 10 Ref.

Descriptors: *Aquifer characteristics, *Sand aquifers, *Groundwater availability, Water table, *New York, Pine Bush, Albany County, Glacial lake, Albany, Groundwater model, Road salt, Water quality.

The 32-square-mile central part of the Pine Bush was studied to determine the availability of ground water in the surficial sand and to assess the quality of the water, especially with respect to phosphorous, nitrogen, and chloride. The surficial sand is from 5 to 150 feet thick and has a hydraulic conductivity of 68 feet per day. Recharge is solely by precipitation. Depth to water is about 10 feet but ranges from 5 to 20 feet locally. The water table and total precipitation have been declining since 1979. A computer model was used to simulate drawdowns that would be produced by pumping the aquifer at various rates. Results indicate that a single well could yield from 150 to 600 gallons per minute, depending on hydraulic conductivity, which was simulated at 25, 50, and 100 feet per day, allowing a maximum drawdown of 80% of total saturated thickness. Ground water contained low phosphorous (maximum of 0.04 mg). (USGS)
W84-00655

ANALYSIS OF THREE TESTS OF THE UNCONFINED AQUIFER IN SOUTHERN NASSAU COUNTY, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
J. B. Lindner, and T. E. Reilly.
USGS Water Resources Investigations Report 82-4021, 1983. 65 p, 10 Fig, 7 Tab, 12 Ref.

Descriptors: *Groundwater, Mathematical models, Analytical techniques, *Aquifer characteristics, *Aquifer testing, Unconfined aquifer, *New York, Long Island, Radial-flow model, Stallman curves, *Drawdown.

Drawdown and recovery data from three 2-day aquifer tests (OF) the unconfined (water-table) aquifer in southern Nassau County, N.Y., during the fall of 1979, were analyzed. Several simple analytical solutions, a typecurve-matching procedure, and a Galerkin finite-element radial-flow model were used to determine hydraulic conductivity, ratio of horizontal to vertical hydraulic conductivity, and specific yield. Results of the curve-matching procedure covered a broad range of values that could be narrowed through consideration of data from other sources such as published reports, drillers' logs, or values determined by analytical solutions. Analysis by the radial-flow model was preferred because it allows for vertical variability in aquifer properties and solves the system for all observation points simultaneously, whereas the other techniques treat the aquifer as homogeneous and must treat each observation well separately. All methods produced fairly consistent results. The ranges of aquifer values at the three sites were: horizontal hydraulic conductivity, 140 to 380 feet per day; transmissivity 11,200 to 17,100 feet squared per day; ratio of horizontal to vertical hydraulic conductivity 2.4:1 to 7:1, and specific yield, 0.13 to 0.23. (USGS)
W84-00658

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2B: SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00660

HYDROGEOLOGY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS - NORTHERN YORK AND SOUTHERN CUMBERLAND COUNTIES, MAINE,
Geological Survey, Boise, ID. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00667

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00668

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00669

SUPPLEMENT TO THE NEW MEXICO THREE-DIMENSIONAL MODEL (SUPPLEMENT TO OPEN-FILE REPORT 80-421),
Geological Survey, Albuquerque, NM. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00678

EFFECTS OF SANITARY SEWERS ON GROUND-WATER LEVELS AND STREAMS, NASSAU AND SUFFOLK COUNTIES, NEW YORK--PART I: GEOHYDROLOGY, MODELING STRATEGY, AND REGIONAL EVALUATION,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 4C.
W84-00679

2G. Water In Soils

WATER-REPELLENT SUBSTANCES AND AGGREGATE STABILITY IN HYDROPHOBIC SOIL,
G. Giovannini, S. Lucchesi, and S. Cervelli.
Soil Science, Vol 135, No 2, p 110-113, February, 1983. 4 Tab, 22 Ref.

Descriptors: *Water repellent soils, *Soil aggregates, *Soil erosion, Erosion, Chelation, Organic matter, Soil physical properties, Soil organic matter, Soil cement.

Solvent extraction of five naturally water repellent clay loam soils from Corleone, Sicily, reduced the water repellency of the samples. Water drop penetration times decreased from 484-540 sec to 124-155 sec with benzene extraction and 130-152 sec with benzene/acetylacetone. The extracts applied to 30 mesh and reduced the water stability index from 53-57 to 44-48 with benzene and to 33-38 with benzene/acetylacetone. Iron and aluminum complexed with organic matter were removed by benzene/acetylacetone, but not by benzene alone. Although aggregation reduces soil erodibility in most soils, in water repellent soils the hydrophobic coating restricts infiltration and causes intensive surface runoff and increased erosion. (Cassar-FRC)
W84-00401

STOCHASTIC ANALYSIS OF ONE-DIMENSIONAL STEADY STATE UNSATURATED FLOW: A COMPARISON OF MONTE CARLO AND PERTURBATION METHODS,
Royal Inst. of Tech., Stockholm (Sweden). Dept. of Water Resources Engineering.
J. Andersson, and A. M. Shapiro.
Water Resources Research, Vol 19, No 1, p 121-133, February, 1983. 18 Fig, 1 Tab, 14 Ref.

Descriptors: *Unsaturated flow, *Soil water, *Infiltration, Stochastic hydrology, Subsurface flow, Hydraulic conductivity, Monte Carlo method, Drainage, Model studies, Spatial variation, Perturbation techniques.

The stochastic nature of moisture content in a soil profile under steady state, unsaturated infiltration is examined, where the saturated hydraulic conductivity is taken as a stationary stochastic process. Two different techniques are employed in determining the stochastic output. These are Monte Carlo simulations and an analytic derivation from a first-order perturbation solution. In comparing the two techniques, the liability of the perturbation expressions is investigated if the Monte Carlo results are assumed to exactly represent the stochastic nature of the moisture content. In four test examples a relatively good comparison is obtained between the results of the two techniques. The analytic nature of the perturbation solution then readily provides information concerning the general stochastic properties of the moisture content, and this way, additional Monte Carlo runs are avoided. From this analysis it is shown that the moisture content is a stationary stochastic process at distances far from boundary regions. The distance from the boundary to regions of stationarity is dependent upon soil properties and the boundary conditions imposed. (Author's abstract)
W84-00407

THE CROSS-COUPLING TRANSPORT COEFFICIENT FOR THE STEADY FLOW OF HEAT IN SOIL UNDER A GRADIENT OF WATER CONTENT,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. Y. Chu, G. Sposito, and W. A. Jury.
Soil Science Society of America Journal, Vol 47, No 1, p 21-25, 1983. 13 Ref.

Descriptors: *Heat flow, *Soil physics, *Thermodynamics, Soil water, Jury-Miller equation.

A theoretical discussion based on the thermodynamics of irreversible processes (TIP) is given concerning the flux equations for the coupled, steady flows of water and heat in a soil as formulated by Jury and Miller (1974). It is shown that a unique definition of the heat flux vector in a coupled flow process is not possible within the context of TIP alone, although differences between heat flux vectors can be defined uniquely. It is shown also that any set of coupled expressions for simultaneous, steady water and heat flow in soil that is compatible with TIP can be used to derive the Jury-Miller formulation of the flux equations by means of linear transformations. Moreover, the cross-coupling coefficient that links the heat flux to the gradient of water content vanishes identically in this formulation. However, a particular definition of the heat flux is implied by the Jury-Miller equations, and its relationship to the measured heat flux cannot be established solely by the methods of TIP. An examination of the data on heat and water flow reported by Jury and Miller indicated that the experimental sensitivity was not sufficient to discriminate among several alternative definitions of the heat flux that can be developed within TIP. This result serves to emphasize the point that the identification of the heat flux actually measured in a coupled flow experiment must be on the basis of either a theoretical model of the coupled flow processes or an application of the general equation of total energy balance. (Author's abstract)
W84-00425

2H. Lakes

MODEL OF LIGHT PENETRATION IN A TURBID LAKE,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. G. Stefan, and J. J. Cardoni.
Water Resources Research, Vol 19, No 1, p 109-120, February, 1983. 21 Fig, 4 Tab, 30 Ref.

Descriptors: *Suspended solids, *Light penetration, Photosynthesis, Oxbow lakes, Turbidity, Lake Chicot, Arkansas, Lakes, Model studies, Radiation, Organic matter.

The attenuation of light with depth of water and the effect of suspended solids (clay, phytoplankton, and organic detritus) on the attenuation were described by equations for Lake Chicot, a 20 sq km highly turbid oxbow lake in Arkansas. Chlorophyll a affected total attentuation coefficients only at high concentrations; inorganic suspended solids dominated light attenuation in this lake. Since light attenuation is a function of wavelength, three bands were distinguished: photosynthetically active radiation, visible light, and total radiation. Light as seen by flat plate sensors and spherically integrated light as experienced by an algal cell were distinguished. A relationship was developed between incident total radiation measured above the water to underwater photosynthetically active radiation. (Cassar-FRC)
W84-00400

SANDY-GRAVELLY MASS-FLOW DEPOSITS IN AN ICE-MARGINAL LAKE (SAALIAN, LEUVENUMSCHE BEEK VALLEY, VELUWE, THE NETHERLANDS), WITH EMPHASIS ON PLUG-FLOW DEPOSITS,
Amsterdam Univ. (Netherlands). Geological Inst.
For primary bibliographic entry see Field 2J.
W84-00416

NUMBER, BIOMASS, AND PRODUCTION OF BACTERIOPLANKTON OF THE KUIBYSHEV RESERVOIR IN 1979,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
A. V. Ivatin.
Water Resources (English Translation), Vol 8, No 6, p 665-670, November-December, 1981. 2 Fig, 4 Tab, 9 Ref. Translated from Vodnye Resursy, No 6, p 159-164, November-December, 1981.

Descriptors: *Reservoirs, *Bacteria, *Population dynamics, Bacterioplankton, Kuibyshev reservoir, Seasonal variation, *USSR.

In 1979 studies were made on the Kuibyshev reservoir to trace the changes in the number and biomass of bacterioplankton in time and space, to compare the time of doubling of the number and biomass of bacteria, and to determine the production of bacterioplankton. The number of bacterioplankton in various stretches of the reservroir during the growing season varied from 0.39 to 4.36 million cells/ml and was highest at the time of the spring flood in May. A decrease of the number of microorganisms with a simultaneous decrease of water turbidity was observed from the upper reaches of the reservoir toward the dam. Significant differences in the number of bacterioplankton were not found in the surface and bottom water layers. The distribution of the bacterioplankton between the surface and bottom layers and its change over the longitudinal profile of the reservoir in general features is similar to the corresponding changes in the number of bacterioplankton. The most intense multiplication and production of biomass occurred in summer, indicating a high activity of the microflora of the reservoir. (Baker-FRC)
W84-00518

IMPACT OF CHANGING ACIDITY ON THE TROPHIC DYNAMICS OF PINE BARRENS PLANKTON COMMUNITIES,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
For primary bibliographic entry see Field 5C.
W84-00684

2J. Erosion and Sedimentation

WATER-REPELLENT SUBSTANCES AND AGGREGATE STABILITY IN HYDROPHOBIC SOIL,
For primary bibliographic entry see Field 2G.
W84-00401

SANDY-GRAVELLY MASS-FLOW DEPOSITS IN AN ICE-MARGINAL LAKE (SAALIAN, LEUVENUMSCHE BEEK VALLEY, VELUWE, THE NETHERLANDS), WITH EMPHASIS ON PLUG-FLOW DEPOSITS,
Amsterdam Univ. (Netherlands). Geological Inst.
G. Postma, T. B. Roep, and G. H. J. Ruegg.
Sedimentary Geology, Vol 34, No 1, p 59-82, 1983. 12 Fig, 39 Ref.

Descriptors: *Lake sediments, *Sediments transport, *Glacial lakes, Paleolimnology, Deposition, Gravel, Sand, Plug flow, Sedimentology, Leuvenumsche Beek Valley, The Netherlands.

Studies of deposits in three sand-gravel pits in the Leuvenumsche Beek Valley, the Netherlands, revealed the existence of an ice-marginal lake. Sediment sequences showed that ice-pushed ridges on either side of the ancient lake had slumped downslope. The sand pits revealed U-shaped channel forms with a maximum depth and width of 10 x 25 m. They are filled with sand, gravels, and giant sand clasts. Just below the base of the channel forms sediments are distorted and folded. This suggests that rigid sediment plugs sheared downslope, generating a finer-grained shear zone around the plug, scouring a slide scar. Evidence of flow pulsations are found in the sediment sequences overlying the plugged U-shaped channel forms. Waning flow conditions are indicated by upwards thinning of the sequence and finer grain size. (Cassar-FRC)
W84-00416

MODELING EROSION ON LONG STEEP SLOPES WITH EMPHASIS ON THE RILLING PROCESS,
Kentucky Univ., Lexington. Dept. of Agricultural Engineering.
M. C. Hirschi, B. J. Barfield, and I. D. Moore.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125129, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Research Report No 148, September 1983. 222 p, 38 Fig, 14 Tab, 135 Ref, 5 Append. OWRT B-072-KY(1), 14-34-0001-0224.

Descriptors: *Erosion, *Soil erosion, Erosion rates, Slope stability, *Model studies, *Slopes, Slope degradation, *Rill erosion, Rills, Rainfall impact, Infiltration.

A model of soil erosion, known as KYERMO, is presented which emphasizes those processes which are important on steep slopes. Particular emphasis is placed on modeling rill development and geometry since this is the least understood process in erosion mechanics. The model requires an input rill pattern. Rainfall inputs to the model require the use of breakpoint rainfall and kinetic energy. Surface storage is calculated on random roughness data of Linden (1979). Infiltration is modeled by use of the two layer Green-Ampt-Mein-Larson model as proposed by Moore and Eigel (1981). Runoff is related to rainfall excess and surface storage by the exponential relationships of Tholin and Kiefer (1960). Erosion is modeled separately as rill and interrill erosion. Interrill erosion is modeled by evaluating raindrop splash and interrill transport capacity. Raindrop splash is predicted by using the Bubenzer and Jones (1971) equation which requires kinetic energy, rainfall intensity, and percent clay. Interrill transport capacity is modeled by either the Yalin (1963) or Yang (1973) equation depending on user preference. The rate of delivery of soil to a rill is a minimum of either the transport rate or splash rate. Rill detachment capacity is calculated using the shear excess equation of Foster (1982). Transport capacity is calculated from either the Yalin (1963) or Yang (1973) depending on user preference. The distribution of detachment around the rill boundry is calculated as a function of the shear distribution. Shear is distributed by using a modification of the area method of Lundgren and Johnson (1964).
W84-00445

WORLD-WIDE DELIVERY OF RIVER SEDIMENT TO THE OCEANS,
Woods Hole Oceanographic Institution, MA.
J. D. Milliman, and R. H. Meade.
Journal of Geology, Vol 91, No 1, p 1-21, 1983. 4 Fig, 4 Tab, 68 Ref.

Descriptors: Rivers, *Oceans, *Sediment transport, Sediment load.

Estimates based on both new and old data indicate that rivers with large sediment loads contribute about 7 x 10 to the 9th power tons of suspended sediment to the ocean each year. The data on which these estimates are based have a number of serious potential errors which need to be considered in either local or world-wide budgets. The most important factor is the widely variable quality of the data as a result of differences in measurement techniques, lengths of observation, and sampling procedures. The sediment loads of the large rivers in North America have been measured for as many as 50 years. Rivers draining the eastern part of the continent have small sediment loads. Rivers discharging into the Gulf of Mexico transport the greatest amount of sediment in the conterminous US. Sediment loads in rivers in the western part of the US are generally considered to be large, but again dams and reservoirs have decreased them considerably. Alaskan rivers that drain glaciers have much greater sediment yields. The largest river, the Amazon, still has a sediment load which is relatively unknown. The rivers that drain Europe are small and carry little sediment. Only the Rhone, Po, and Danube Rivers appear to have annual sediment discharges in excess of 10 x 10 to the 6th power tons. The Eurasian Arctic is drained by three large rivers, the Ob, Yenisei and Lena, all having drainage areas of about 2,500,000 sq km and water discharges of 385 to 560 cubic km/yr. However, the areas have been largely stripped of sediment by Pleistocene glaciers. River drainage in China and in the Asian continent exclusive of China are also considered. About 70% of the total river sediment delivered to the oceans is derived from southern Asia and the larger islands in the Pacific and Indian Oceans. (Baker-FRC)
W84-00575

PETROLOGY, CHEMISTRY, AND TEXTURE OF MODERN RIVER SANDS, AMAZON RIVER SYSTEM,
Amazonas Univ., Manaus (Brazil).
E. Franzinelli, and P. E. Potter.
Journal of Geology, Vol 91, No 1, p 23-39, 1983. 8 Fig, 6 Tab, 41 Ref.

Descriptors: *Sedimentation, *Sediment transport, Rivers, *Sand, Minerals, Quartz, *Amazon River, Subarctic regions, Temperate zones, Brazil, Peru, Ecuador, Colombia.

The thin section petrology and texture of the light minerals of 95 modern sands collected from the Amazon river system in Brazil and adjacent parts of Columbia, Ecuador, and Peru were examined. The sands derived from the Andes are lithic arenites, whereas sands derived from Precambrian terrains are much richer in quartz. Sands in rivers draining Tertiary molasse are also rich in quartz. Sand becomes more mature downstream along the main stem of the Amazon-Soliomes-Maranon, so that a sample analyzed at the mouth does not accurately reflect composition of the headwater. Enhanced maturity downstream results from dilution by quartz-rich tributaries and quartz-rich Tertiary outcrops, possible differential elimination of rock fragments, and even possible weathering on the modern flood plain of the Amazon. It is suggested that large subarctic and temperate rivers do not have a marked downstream increase in mineralogic maturity. River sands of Precambrian watersheds are coarser than those derived directly from either the Andes or from those derived from Tertiary molasse for two apparent reasons. First, Precambrian granites have coarser quartz than the reworked quartz of a major geosyncline, and second, tropical weathering eliminates quartzofeldspathic rock fragments much more rapidly than quartz. (Baker-FRC)
W84-00576

2K. Chemical Processes

IRON MINERALIZATION OF PERITIDAL CARBONATE SEDIMENTS BY CONTINENTAL GROUNDWATERS, FISHERMAN BAY, SOUTH AUSTRALIA,
Baas Becking Geobiological Lab., Canberra (Australia).
J. Ferguson, R. V. Burne, and L. A. Chambers.
Sedimentary Geology, Vol 34, No 1, p 41-57, 1983. 6 Fig, 3 Tab, 24 Ref.

Descriptors: *Iron, *Geochemistry, *Aquifer properties, Manganese, Fisherman Bay, Australia, Chemical precipitation, Sediments, Groundwater, Saline water, Geology, Bays.

Iron and manganese are precipitating from saline groundwaters flowing towards the hypersaline waters of Fisherman Bay, South Australia, from red bed aquifer systems in the coastal plain. In one area a lens-shaped body 500 sq m in area and 20 cm thick has formed. This contains ferric oxide at concentrations of 30%-70% by weight. Saline groundwaters associated with the iron mineralization contain up to 67.3 ppm Fe with pH of about 6. These high Fe concentrations are probably caused by: (1) adequate and readily soluble Fe in the aquifer, (2) biological activity which lowers the electrical conductivity without limiting Fe solubility by production of hydroxide or sulfide ions, and (3) absence of buffering minerals. Fe and Mn are separated in the bay sediments because Fe separates first, followed by Mn on the seaward fringe, where carbonates are found. The groundwaters in the aquifer system are potential ore-forming fluids. The present bay deposit has formed within 2000 to 6000 years. (Cassar-FRC)
W84-00418

THE COMPOSITION AND DEPOSITION OF ORGANIC CARBON IN PRECIPITATION,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
G. E. Likens, E. S. Edgerton, and J. N. Galloway.
Tellus, Vol 35B, No 1, p 16-24, 1983. 1 Fig, 3 Tab, 34 Ref.

Descriptors: *Precipitation, *Organic carbon, Deposition, Acid rain, Particulate matter, Organic acids, Hubbard Brook, New Hampshire, Ithaca, New York, Forest watersheds, Chemical composition, Fate of pollutants, Water pollution sources.

Wet-only precipitation collected at Hubbard Brook (HB), New Hampshire, a heavily forested site, and Ithaca, New York, from June 1976 to May 1977 was analyzed for several types of organic carbon. Annual volume weighted mean concentrations (mg per liter) were: total organic carbon, 2.37 at Ithaca and 1.28 at HB; dissolved organic carbon, 1.88 at Ithaca and 1.09 at HB; and particulate organic carbon, 0.49 at Ithaca and 0.20 at Hubbard Brook. Deposition of total organic carbon was 24,230 g per ha at Ithaca and 14,031 g per ha at HB. Organic material concentrations and rainfall levels were highest in June-September. Particulate plus dissolved macromolecular (>1000 MW) organic matter accounted for 51% and 63% of total organic carbon at HB and Ithaca, respectively. The remainder of the carbon, the fraction containing compounds of <1000 MW, consisted largely of carboxylic acids, aldehydes, carbohydrates, tannin/lignin, primary amines, and phenols. Sources of the organic materials were airborne soil dust and plant material. The organic acids present in the rain at HB contributed only 2% of the total acidity. (Cassar-FRC)
W84-00424

ACID PRECIPITATION IN SOUTHEASTERN WYOMING,
Wyoming Univ., Laramie. Water Resources Research Inst.
J. Ahern, and C. Baird.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132521, Price codes: A06 in paper copy, A01 in microfiche. Completion Report, September 1983. 96 p, 3 Fig, 17 Tab, 33 Ref, 6 Append. OWRT A-032-WYO(1), 14-34-0001-1154.

Descriptors: *Acid rain, Snow, Snowpack, Chemical properties, Hydrogen ion concentration, Chemical analysis, Laramie, *Wyoming, Snowy range.

Snowfall, snowpack, and rainfall samples were collected in Laramie, Wyoming and in the Snowy Range west of Laramie from March to June 1981 to determine the occurrence and sources of acid precipitation in southeast Wyoming. Electrodes measured different pH values in the samples; how-

ever, fast-response electrodes yielded higher and apparently more accurate pH measurements. The pH values in the Laramie precipitation and snowpack were typically greater than 5.0, but all the Snowy Range snowpack pH values were less than 5.0. The lower pH values in the Snowy Range snowpack were caused by higher concentrations of the acid-forming nitrate and lower concentrations of the neutralizing calcium. Two organic species, formate and acetate, were detected in the Laramie samples, but had no significant influence on the acidity of the samples.
W84-00639

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING--A WATER SUPPLY ALTERNATIVE FOR VIRGINIA BEACH,
Pirnie (Malcolm), Inc., Newport News, VA.
M. P. Robinson, Jr., G. P. Westerhoff, and T. M. Leahy, III.
Journal of the American Water Works Association, Vol 75, No 3, p 109-117, March, 1983. 8 Fig, 5 Tab, 15 Ref.

Descriptors: *Water supply, *Brackish water, *Wastewater renovation, Desalination, Water treatment, Virginia Beach, Virginia, Membrane processes, Costs, Reverse osmosis, Water demand, Social aspects, Seawater, Demineralization, Energy, Regulations.

Desalting of brackish groundwater was chosen as a short-term practical alternative in a cost evaluation of 24 water supply options for Virginia Beach, Virginia. The city currently receives its water from Norfolk, which may not be able to satisfy water demands by the year 2000. The alternatives were grouped into 7 general headings: expanding regional surface water impoundments, expanding the Norfolk system, developing impoundments already existing, developing shallow groundwater aquifers, developing regional groundwater supplies, reclaiming wastewater, and desalting brackish groundwater or seawater. Costs per 1000 gal for several treatment techniques were: brackish water, $1.80-2.00; wastewater reclamation, $3.10-4.60; and seawater, $4.30-6.00. Improvements in reverse osmosis and other membrane processes are expected to reduce present costs by as much as 50%. However, energy costs are a highly significant part of cost evaluation. Wastewater reclamation and seawater desalting have the greatest promise for a long-term solution to Virginia Beach's water supply problems. (Cassar-FRC)
W84-00387

WIPED-FILM ROTATING-DISK EVAPORATOR FOR WATER REUSE,
California Univ., Berkeley. Water Thermal and Chemical Technology Center.
B. W. Tleimat, and T. Vermeulen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120880, Price codes: A05 in paper copy, A01 in microfiche. Technical Report RU-S2/15, U.S. Dept. of the Interior/OWRT, Washington, D.C., November 1982. 62 p, 20 Fig, 4 Tab, 14 Ref, 3 Append. OWRT C-00165-R(No 0537)(1), 14-34-0001-0537.

Descriptors: *Rotating-disk evaporator, *Wiped film. Distillation, Heat transfer, Energy consumption, Heat-transfer coefficient prediction and measurement, Modular design, Water reuse.

Two different disk designs for the wiped-film rotating-disk evaporator were built in order to compare their heat-transfer performance. In one design, 1 mm thick brass disks were spun-formed on a spherical mold; in the other, 0.8 mm-thick brass disks were made flat and the outside flange was formed by spinning. The heat-transfer coefficient was not influenced by the disk shape, but was affected unfavorably by surface roughness. Its analytical prediction agreed well with experimental results, showing overall heat-transfer coefficients as high as 28 kW/m super 2C (8000 Btu/hr ft super 2F) and 23 kW/m super 2C (6500 Btu/hr ft super 2F) for copper and brass disks respectively. A conceptual design of a five-effect vapor-compression system to desalt 10 m super 3/day (2500 gallons/day) from seawater was made and costed. Based on data obtained, with an overall temperature difference of 1.5F across the heat-transfer surface, the energy consumption by the compressor (50% isentropic efficiency) was calculated to be 6.2 kWh/m super 3 (23.6 kWh/1000gal) of product.
W84-00438

DEVELOPMENT OF A LARGE SPIRAL MODULE FOR SEAWATER DESALINATION BY REVERSE OSMOSIS,
UOP, Inc., San Diego, CA. Fluid Systems Div.
G. E. Foreman, and J. E. Beckman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125111, Price codes: A05 in paper copy, A01 in microfiche. Completion Report, September 1983. 53 p, 6 Fig, 3 Tab, 3 Append. OWRT C-80344-S(No 8573)(1), 14-34-0001-8573.

Descriptors: *Desalination apparatus, *Reverse osmosis, *Membrane filters, Reverse osmosis modules.

Work under OWRT Contract No. 14-34-0001-8573 was directed toward the development and testing of 12-inch diameter seawater reverse osmosis modules. The major development was the pressure tube assembly which resulted in the selection of an epoxy/fiberglass (FRP) pressure tube having an initial burst pressure in excess of 7200 psi. Safety as well as functionality was of prime importance. Twelve inch diameter spiral-wound elements containing 700 ft super 2 of active membrane were fabricated and ultimately tested at the Government Test Facility located at Wrightsville Beach, North Carolina. The modules provided performed well mechanically during the testing period verifying the tube design developed during the Contract. The elements, although sound mechanically, did not produce the quantity and quality of water originally anticipated. Chlorine in the feedwater caused some failures. It is suspected also that the product water channel material utilized may have contributed to lower than expected permeate flow.
W84-00444

OPTIMAL SELECTION OF MAJOR EQUIPMENT IN DUAL PURPOSE PLANTS,
Italconsult, Rome (Italy).
E. Gabbrielli.
Desalination, Vol 36/1, Jan 1981, p 1-23, 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Desalination, Desalination plants, Dual purpose plants, *Economic evaluation, Combustion turbines, *Multistage flash distillation, Optimization.

Simulation of different operational conditions with the aid of a computer program is one of the best ways of assisting decision-makers in the selection of the most economic mix of equipment for a dual purpose plant. An economic comparison is provided of plants consisting of MSF desalinators and combustion gas or back pressure steam turbines coupled to low capacity electric power generators. The comparison is performed on the basis of the data made available by the OPTDIS computer program and the results are given in terms of yearly cost of production as the sum of capital, manpower, maintenance, fuel and chemical costs.
W84-00449

DEVELOPMENT OF A NEW ASYMMETRIC ALLOY MEMBRANE FOR WATER DESALINATION,
Toulouse-3 Univ. (France). Lab. de Chimie-Physique et Electrochimie.
P. Aptel.
Desalination, Vol 36/1, Jan 1981, p 25-37, 8 Fig, 3 Tab, 9 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, Polymers, Asymmetric membranes, Poly(4-vinylpyridine), *Cellulose acetate.

The preparation of a novel asymmetric membrane case from a poly (4-vinylpyridine) and cellulose acetate homogeneous mixture is discussed. The two polymers were miscible in concentrated solutions. Asymmetric membranes were cast from a sexted dope mixture containing: chloroform, methanol, acetone and formamide. The as-cast solution, when coagulated in water at ambient temperature, yields a highly plasticized asymmetric matrix which, upon slow diffusion of the chloroform into the water, solidifies into a glassy state. The membranes following this stage, do not require annealing and yield high fluxes and salt rejection when tested in reverse osmosis. The asymmetric morphology was confirmed by scanning electron microscopy studies which revealed a dense skin resting upon a highly porous, open-celled, foam-like structure. This structure retains its origianal wet dimensions upon drying. Brief attempts to quaternize the matrix are also reported.
W84-00450

ASYMMETRIC REVERSE OSMOSIS AND ULTRAFILTRATION MEMBRANES PREPARED FROM SULFONATED POLYSULFONE,
Centre National de la Recherche Scientifique, Paris (France). Lab. de Physicochimie Structurale et Macromoleculaire.
C. Freidrich, A. Driancourt, C. Noel, and L. Monnerie.
Desalination, Vol 36/1, January 1981, p 39-62, 14 Fig, 5 Tab, 15 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, Ultrafiltration, Asymmetric, *Polysulfone membranes, Solubility.

The concept of solubility parameter, developed by Hansen, was applied to the determination of solubility diagram of polysulfone and sulfonated polysulfone. Data showing the effect of various parameters such as thermodynamic quality of the solvent, casting solution composition and viscosity, solvent evaporation period and precipitation bath composition, on membrane structure and performance were presented. By adjusting these parameters a wide variety of sulfonated polysulfone membranes useful for both ultrafiltration and reverse osmosis applications could be obtained.
W84-00451

ASYMMETRIC POLIVINYLIDENFLUORIDE (PVDF) RADIATION GRAFTED MEMBRANES: PREPARATION AND PERFORMANCE IN REVERSE OSMOSIS APPLICATION,
Genoa Univ. (Italy). Inst. of Industrial Chemistry.
F. Vigo, G. Capannelli, C. Uliana, and S. Munari.
Desalination, Vol 36/1, Jan. 1981, p 63-73, 8 Fig, 18 Ref.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, *Membranes, Asymmetric, PVDF films, Gels.

A type of reverse osmosis membrane was synthesized. Membranes were prepared starting from asymmetric PVDF films, obtained by the casting and gelation technique and modified by radiochemical grafting and sulphonation. These membranes were tested in an RO laboratory plant and their performances were determined as a function of preparative parameters. The influences of evaporation time and temperature grafting and solvents were investigated. These membranes exhibit permeabilities as high as 2000 l/m super 2 d and sodium chloride rejections up to 70%.
W84-00452

PARAMETRIC STUDY OF COST FACTORS IN RO DESALINATION (GKSS PLATE SYSTEM),
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)
J. Kaschemekat, and K. W. Boddeker.
Desalination, Vol 36/1, January 1981, p 75-85, 9 Fig, 5 Ref.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Membranes, GKSS plate system, *Computers.

Results of a computer-aided analysis of the individual effects of some typical system-related and operating parameters on product water costs in the RO desalination of brackish water and seawater by means of the GKSS plate system are presented.
W84-00453

INVESTIGATION OF PURIFICATION MECHANISM IN A COLUMN CRYSTALLISER OPERATING UNDER TOTAL REFLUX AND CONTINUOUS CONDITIONS,
City Univ., London (England).
G. T. Arulampalam, C. Bates, L. F. Khaw, and L. McGrath.
Desalination, Vol 36/1, January 1981, p 87-97, 8 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination, Desalination plants, Continuous column, *Crystallizers, Indirect refrigeration, *Freezing, Water purification.

Laboratory work was continued on the design and operation of continuous column crystallizers. In order to elucidate the dominant factor in the purification process, an extractive washing model has been utilized to calculate values of the diffusion and mass transfer groups. Total reflux and continuous feed conditions were used. The size and shape were investigated of the ice crystals formed in the freezing section of the column. Modification of the screw conveyer was necessary to facilitate crystal removal.
W84-00454

THE EFFECT OF PRESSURE ON THE BULK POLYMER MICROSTRUCTURE IN CELLULOSE ACETATE REVERSE OSMOSIS MEMBRANES,
Zagreb Univ. (Yugoslavia). Faculty of Pharmacy and Biochemistry.
G. Arneri.
Desalination, Vol 36/1, January 1981, p 99-104, 3 Fig, 16 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Reverse osmosis, Polymers, Microstructure pressure, Differential scanning calorimetry.

The pressure effect on the bulk polymer microstructure was investigated using Differential Scanning Calorimetry (DSC). The samples of both 'dense' CA-398-3 membranes and Kesting dry asymmetric CA-398-3 membranes investigated. The pressure treatment is also a kind of an 'annealing' process that orders the polymer microstructure. The effect takes place both in the case of the originally more ordered (from a DSC point of view) polymer microstructure of 'dense' CA membranes and the originally less ordered (almost completely amorphous) polymer microstructure of the dry asymmetric CA membranes investigated. DSC curves on the thermoanalytical diagrams of the pressure treated 'dense' CA membranes show mainly a shift of the endothermic peak (melting processu) to higher temperatures, and DSC curves of the pressure treated Kesting dry asymmetric membrane samples show both a shift of the endothermic peak to higher temperatures and quite an enlargement of the area under the peak. Pressure action orders (densifies) the bulk polymer microstructure of both the skin and porous layer of an asymmetric CA reverse osmosis membrane.
W84-00455

AN EXPERIMENTAL STUDY OF SPRAY FLASH EVAPORATION,
Kyushu Univ., Fukuoka (Japan). Research Inst. of Industrial Science.
O. Miyatake, T. Tomimura, Y. Ide, and T. Fujii.
Desalination, Vol 36, No 2, February 1981, p 113-128, 11 Figs, 1 Tab, 16 Refs.

Descriptors: *Desalination, *Distillation, Jets, *Flash evaporation, Sprays.

Spray flash evaporation was studied occurring in a superheated water jet injected through a circular tube nozzle into a low-pressure vapor zone. The effects of superheat, flow rate and nozzle diameter on spray flashing were pursued at 60C jet inlet temperature. From the experimental results, an empirical equation suitable for predicting the variation of liquid temperature with residence time was deducted.
W84-00456

PERFORMANCE OF A POLYPHOSPHATE-BASED SCALE CONTROL ADDITIVE IN AN MSF PLANT OF KUWAIT,
Kuwait Water Resources Development Centre, Shamiya.
F. H. Butt, and A. H. Bou-Hassan.
Desalination, Vol 36, No 2, February 1981, p 129-136, 4 Figs, 1 Tab, 4 Refs.

Descriptors: *Desalination, Desalination plants, *Distillation, Multistage flash, Kuwait, Polyphosphate-based additive, *Scaling.

Test of a polyphosphate-based scale control additive, carried out for a period of 8 months during 1978, showed that it was only moderately effective as a scale inhibitor. The gained out-put ratio, which was close to the design value of 8.0 at the start-up, declined by 30% during the test period while the distillate output fell off by about 25% in the same period. Even though the brine heater steam temperature was progressively increased from 93.3C to 118.3C, a steady decline was observed in the heater inlet and outlet temperatures which decreased from 81.7 to 73.3C and 86.7 to 79.4C respectively. It took only 40 days of operation for the heater fouling factor to exceed the design value. The fouling factor registered a five to seven-fold increase in 8 months.
W84-00457

A COMPARISON OF THE RELATIVE ECONOMICS OF SEA WATER DESALINATION BY VAPOUR COMPRESSION AND REVERSE OSMOSIS FOR SMALL TO MEDIUM CAPACITY PLANTS,
Israel Desalination Engineering Ltd., Tel-Aviv.
R. Matz, and U. Fisher.
Desalination, Vol 36, No 2, February 1981, p 137-151, 4 Figs, 8 Tab, 11 Refs.

Descriptors: *Desalination, Desalination plants, Seawater, *Vapor compression, *Reverse osmosis.

Lowest energy consumption is not necessarily the determining criterion for lowest cost sea water desalination. It is shown that at present-day market prices for plants, electrical energy, and fuel oil, Vapour Compression plants with horizontal aluminium tubes - the 'Ambient Temperature' Vapour Compression (ATVC) system - compares economically with Sea Water Reverse Osmosis (SWRO) even at the lowest net energy consumption achieved by the latter process by the use of high efficiency energy recovery turbines. This economic parity is shown to apply for plants of up to 4000 m super 3/day (1 mgd), and is shown to be maintained for future foreseeable developments resulting in reduced energy consumptions and more efficient plants. More areas for potential improvements are available for ATVC, than for SWRO, which may result in more favorable economics for the former process in the future.
W84-00458

REVERSE OSMOSIS IN THE DESALINATION OF BRACKISH WATER AND SEA WATER,
Hager and Elsasser G.m.b.H., Stuttgart (Germany, F.R.).
H. Ludwig.
Desalination, Vol 36, No 2, February 1981, p 153-178, 20 Figs, 5 Tab, 20 Refs.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Seawater, Brackish water, *Polyamide hollow fiber modules.

To make RO an economical process, plant and operating costs have been reduced by developing compact modules, led by polyamide hollow fiber modules which recover energy from the reject when desalinating highly saline brackish water and seawater. Such plants only start to pay their way at product rates of around 400 cu m /d plus. Energy costs for desalination systems with lower capacities can also be reduced considerably by operating the RO plants at conversion rates of more than 30%. To what extent the required higher conversion rates can be obtained for a particular application depends on concentration of scale-forming content matter (calcium sulphate, strontium sulphate, barium sulphate and calcium carbonate), salt content of the raw water, concentration of fouling substances such as iron, manganese, anorganic and organic matter, risk of biological growth due to algae, shells and bacteria. The scope and type of conditioning and pretreatment are based on these factors.
W84-00459

APPLICATION OF REVERSE OSMOSIS TO AUTOMOTIVE ELECTROCOAT PAINT WASTEWATER RECYCLING,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
J. E. Anderson, W. S. Springer, and G. G. Strosberg.
Desalination, Vol 36, No 2, February 1981, p 179-188, 2 Figs, 4 Tab, 11 Refs.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Wastewater treatment, *Automative electrocoat paint, Water reuse.

Field and bench-scale RO experiments on wastewater derived from automotive electrocoat paint operations are reported. Field experiments were performed continuously over a 6 month interval using a RO unit equipped with cellulose acetate membranes. An operating pressure of 3100 kPa (450 psi) and a temperature of 24-27C was maintained. These RO experiments were unusual for two reasons. First, certain solutes in the feedwater were allowed to permeate through the membrane along with water. This was done to permit solute recycling and reuse. Since these solutes (ethyl, butyl and hexyl glycol ethers) were present in a 3% total concentration in the feedstream, their permeation through the membrane eliminated a flux reduction mechanism. This would arise from the increased upstream osmotic pressure if these solutes were concentrated. The experiments were performed under conditions where colloidal lead was present. This caused limited membrane fouling which was controlled via weekly cleaning with dilute lactic acid. Some supporting bench-scale RO experiments were carried out to probe factors influencing this RO application.
W84-00460

SOLAR DISTILLATION: THE SOLAR-ASSISTED CASE.
Sydney Univ. (Australia). Dept. of Chemical Engineering.
J. P. Gerofi, and G. G. Fenton.
Desalination: Vol 36, No 2, February 1981, p 189-204, 11 Figs, 1 Tab, 10 Refs.

Descriptors: *Desalination, Desalination plants, *Distillation, *Solar stills.

The case is considered where a solar collector system, without storage, is linked to an otherwise stand-alone, fuel-driven desalination plant. The choices involved in selecting the type of solar collector and the design constrains on other components of the thermal source loop are outlined. A rationale is outlined for determining the most economic collector area for such a situation and the proportion of the plant's energy requirement that can be provided by solar energy is discussed. Results for a specific collector desalination plant system, which include the effect of solar collector cost and fuel oil price on the economics, are presented. The decisions and constraints involved in selecting an optimum solar-assisted desalination system for a particular application are outlined.
W84-00461

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

RAYLEIGH-JEFFREYS STABILITY OF THERMOHALINE STRATIFIED FLUIDS SUBJECT TO VERTICAL FLOWS,
Technion - Israel Inst. of Tech., Haifa. Energy Engineering Center.
M. Bouscher, D. Pnueli, and Y. Zvirin.
Desalination, Vol 36, No 3, March 1981, p 307-333, 1 Fig, 9 Ref.

Descriptors: *Desalination, *Hydrodynamics, Fluid mechanics, Rayleigh-Jeffreys stability, Thermohaline stratified fluids.

The stability of an infinite horizontal layer of fluid with a density stratification due to both temperature and solute gradients, subject to an initial vertical flow field, is studied for different sets of homogeneous boundary conditions. Sufficient conditions for the maintenance of the original stratification, i.e. for stability, are obtained as a relation between the thermal Rayleigh number, and the solute Rayleigh number. A relation is obtained as a sufficient condition for stability for all sets of boundary conditions, and shows that the ratio of the solute to the thermal Rayleigh numbers is less than the negative of the square of the ratio of the solute is the thermal Prandtl numbers. This condition may thus be applied to cases in which the physical boundary conditions are not well defined, e.g. to practical engineering use of solar ponds. In addition, in conjunction with a similar result for initial horizontal flow fields, the result gives a sufficient condition for stability of arbitrary initial flows under all combinations of boundary conditions.
W84-00462

REVERSE OSMOSIS WITH A CELLULOSE ACETATE MEMBRANE IN THE REVERSE ORIENTATION,
Leiden Rijksuniversiteit (Netherlands). Gorlaeus Labs.
J. A. M. Smit.
Desalination, Vol 36, No 3, March 1981, p 291-297, 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Cellulose acetate membranes.

Salt rejection curves of Cellulose acetate membranes placed with the porous layer towards the influent side and the skin towards the effluent side show typical maxima. Analysis of these maxima yields information on the salt permeabilities of the porous layer and of the skin in a rather direct way.
W84-00463

CONCENTRATION OF CUPRIC AND NICKEL IONS BY COMPLEXATION-ULTRAFILTRATION, SYNERGIC EFFECT OF SUCCINIC ACID,
Centre National de la Recherche Scientifique, Nancy (France). Lab. de Chimie Physique Macromoleculaire.
Q. T. Nguyen, Y. Jyline, and J. Neel.
Desalination, Vol 36, No 3, March 1981, p 277-283, 4 Fig, 6 Ref.

Descriptors: *Desalination, Ultrafiltration, Copper, Nickel, Ions, Succinic acid.

In ultrafiltration, high rejection of small ion species can be achieved by complexing these species with a suitable macroligand. The concentration was studied of cupric and/or nickel ions by ultrafication, through the DDS GR8 membrane, using polyethylenimine as a basic macroligand. The rejections of the metallic ions increased with the pH and the concentration of the polymeric ligand as expected. The addition of succinic acid (a molecular acidic chelating) to the mixtures allowed an improvement of the retentions of these ions at all pHs studied. This indicates that positive synergic effect was obtained by the formation of a mixed complex base-metal-acid.
W84-00464

ADSORPTION OF WATER ON CELLULOSE ACETATE MEMBRANE,
Tohoku Univ., Sendai (Japan). Faculty of Engineering.
Y. Kurokawa.
Desalination, Vol 36, No 3, March 1981, p 285-290, 3 Fig, 2 Tab, 3 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Cellulose acetate, Casting, Adsorption.

The effect was studied of variables of cellulose acetate membrane procedure on its reverse osmosis properties by adsorption of water vapor. The rate of adsorption of vapor was slower for the membrane prepared at casting condition of longer evaporation period. This variation corresponded to that of water permeability by reverse osmosis performance. It seems from the isotherm data that the overall porosity of membrane is determined during the evaporation step. This provides additional support for membrane properties depending on casting conditions.
W84-00465

EFFECTS OF ACCELERATION ON REVERSE OSMOSIS DESALINATION.
SRI International, Menlo Park, CA.
G. B. Andeen.
Desalination, Vol 36, No 3, March 1981, p 265-275, 5 Fig, 8 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, Reverse osmosis, Hollow fine fibers, Acceleration.

Hollow-fine-fiber reverse osmosis elements were run in a continuous-flow centrifuge at accelerations up to 1000 G. Under acceleration, the elements produced more desalted water and passed less salt, showing a reduction of concentration polarization. Reduced data showed that the mass transfer coefficient of salt from the membrane surface to the bulk of the brine increased with acceleration to the 0.3 power. Acceleration also improved flow distribution by eliminating regions of high-density stagnant brine. Use of a centrifuge will allow utilization of higher transport membranes.
W84-00466

A CRITICAL REVIEW OF FOULING OF REVERSE OSMOSIS MEMBRANES,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
D. E. Potts, R. C. Ahlert, and S. S. Wang.
Desalination, Vol 36, No 3, March 1981, p 235-264, 1 Fig, 94 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, Fouling, *Water reuse, Wastewater treatment.

Reverse osmosis technology is presently undergoing rapid growth in the area of municipal and industrial wastewater reuse. Control of membrane fouling due to organic compounds and particles in wastewater is a major expense in the design and operation of these facilities. A general overview is given of what is known about the fouling process, and technology used to deal with the problem is described. Current research in the field is reviewed, including some recent developments in modeling and fouling control.
W84-00467

RECENT DEVELOPMENTS IN THIN-FILM COMPOSITE REVERSE OSMOSIS MEMBRANE SYSTEMS,
UOP, Inc., San Diego, CA.
R. L. Riley, P. A. Case, A. L. Lloyd, C. E. Milstead, and M. Tagami.
Desalination: Vol 36, No 3, March 1981, p 207-233, 17 Fig, 8 Tab, 20 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Water reuse, Thin film composite membranes, Jeddah, Saudi Arabia.

Desalination of seawater by reverse osmosis requires a membrane which approaches theoretical semipermeability and is sufficiently thin to provide transport of water at practical operating pressures and recovery rates. This objective has been achieved by the development of a family of thin-film composite membranes based on nitrogen-containing polymers supported on a fabric-reinforced porous supporting membrane. The membranes, packaged in the spiral-wound configuration, exhibit high water permeability, low salt permeability, thermal stability, resistance to micro-organisms, wet-dry, and chemical stability. Membranes of this type are currently employed for the conversion of seawater to potable water in the world's first large RO plant in Jeddah, Saudi Arabia, trailer-mounted U.S. Army military units, off-shore drilling platforms, marine applications, and handpowered emergency units. RO systems, employing thin-film composite membrane elements, are also in operation for the conversion of brackish to potable water and a variety of water-reuse applications for textile finishing, boiler water for electrical utilities, soft drink manufacturing, agricultural water, and reclamation of municipal waste water.
W84-00468

PILOT AND FULL-SCALE RESEARCH ON THE VAPOUR COMPRESSION DESALINATION PROCESS,
Rome Univ. (Italy). Inst. of Physical Chemistry.
M. Beccari, A. C. Di Pinto, A. Rozzi, M. Santori, and L. Spinosa.
Desalination, Vol 37, No 3, June 1981, p 257-268, 7 Fig, 2 Tab, 10 Ref.

Descriptors: *Desalination, Desallnation plants, *Vapor compression, Distillation, Vertical tube bundle, Falling brine film, Heat transfer.

Pilot-scale tests were carried out in order to learn more about the vapor compression process at moderately high temperature (around 100C). On the basis of the results obtained, a demonstration plant (about 240 m super 3/d) was built in order to test the actual validity of the process developed. Using a new type compressor the energy consumption was satisfactorily low. By the use of a vertical tube bundle with falling brine film established by screw distributors, it was also possible to obtain high overall heat transfer coefficients.
W84-00470

COMPARATIVE ANALYSIS OF THE EFFICIENCY OF THERMAL DESALINATION PLANTS,
Dalnevostochnyi Politekhnicheskii Inst., Vladivostok (USSR).
V. Slesarenko, and A. Shtim.
Desalination, Vol 37, No 3, June 1981, p 269-277, 2 Fig, 4 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, Economics, Thin film, Seawater, Heat transfer.

In the desalination of seawater, energy heat transfer losses are greatest. Thin film thermal desalination plants were found to have the best hydrodynamic, technical, and economic properties.
W84-00471

SCALE DEPOSITION IN A LAMINAR FALLING-FILM SYSTEM,
Technion - Israel Inst. of Tech., Haifa. Dept. of Chemical Engineering.
D. Hasson, and I. Perl.
Desalination, Vol 37, No 3, June 1981, p 279-292, 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Desalination, *Calcium carbonate, *Scaling, Transport theories, Laminar-flow, Falling-film system.

The mechanism of CaCO sub 3 scale deposition from a laminar falling-film is analyzed. Theoretical models are presented, taking into account the effects of water composition and hydrodynamic conditions. The models demonstrate a method for applying transport theories in analyzing diffusional effects occurring during scale deposition in a falling-film system. Analysis of experimental results

shows that diffusional effects can be of importance even in thin-film flow. The data may be used to predict the minimum expected CaCO sub 3 scale deposition rate in a laminar flow falling-film system under evaporative, nonboiling, conditions.
W84-00472

STUDIES ON SYNTHESES AND PERMEABILITIES OF SPECIAL POLYMER MEMBRANES. 40. FORMATION CONDITIONS OF FINGER-LIKE CAVITIES OF CELLULOSE NITRATE MEMBRANES,
Kansai Univ., Osaka (Japan). Dept. of Chemistry.
T. Uragami, Y. Ohsumi, and M. Sugihara.
Desalination, Vol 37, No 3, June 1981, p 293-305, 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, Polymers, Finger-like cavities, *Cellulose nitrate membranes.

The permeation characteristics for polymer aqueous solution and asymmetric structure of cellulose nitrate membranes, in particular the finger-like cavity in the back sponge layer of these membranes, were investigated by changing the preparation conditions of the membranes - the casting solvent, evaporation period, and gelation medium. The formation of the finger-like cavity was dependent on absorption of a water molecule into the casting mixture from the atmosphere during the solvent evaporation process and the exchange velocity between the casting solvent and the gelation medium. The mechanism and conditions for the formation of a finger-like cavity in cellulose nitrate membranes were discussed.
W84-00473

IRREVERSIBLE FOULING CAUSED BY PLASTICIZATION OF ASYMMETRIC REVERSE OSMOSIS MEMBRANES,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
J. E. Anderson, M. E. Heyde, and H. K. Plummer, Jr.
Desalination, Vol 37, No 3, June 1981, p 307-311, 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, *Membranes, Fouling, Plasticization, Asymmetric membranes, Cellulose acetate.

Bench-scale reverse osmosis measurements have been performed on aqueous solutions of phenol, p-nitrophenol, aniline, coumarin, sodium lauryl sulfate and sodium naphtalene sulfonate. Asymmetric cellulose acetate membranes were used. Low concentrations of dissolved organics produce modest reversible reductions of permeate flux. Higher concentrations of aniline dissolve the membrane, while high phenol concentrations effectively plasticize the membrane removing its asymmetric structure. Electron micrographs of plasticized and unplasticized membranes are shown.
W84-00474

AMPHOTERIC MEMBRANE PREPARATION AND THEIR APPLICATION TO SALINE WATER HYPERFILTRATION,
Genoa Univ. (Italy). Inst. of Industrial Chemistry.
F. Vigo, G. Capannelli, and S. Munari.
Desalination, Vol 37, No 3, June 1981, p 313-324, 10 Fig, 1 Tab, 17 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Hyperfiltration, Radiochemical grafting, Amphotevil membrane.

A new type of amphoteric membranes can be synthesized by means of radiochemical grafting followed by selective chemical reactions. Thus polyetrafluoroethylene films were grafted with styrene/4-vinyl pyridine mixtures, and then reacted with chlorosulphonic acid and methyliodide to obtain membranes containing both -SO-s ub 3 and -N-CH+ sub 3 groups. Such membranes were tested in a RO plant and their performances with brackish water checked.
W84-00475

UTILIZATION OF WASTE OF HOT WATER FOR DISTILLATION,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
M. S. Sodha, A. Kumar, and G. N. Tiwari.
Desalination, Vol 37, No 3, June 1981, p 325-342, 9 Fig, 2 Tab, 8 Ref.

Descriptors: *Desalination, Desalination plants, Distillation, *Solar stills, Wastewater utilization, *Heated water.

The yield of a solar still can be increased by introducing hot feed water available from power and chemical plants; even in the absence of sun appreciable yields are obtained. The performance of a solar still was studied in two modes of wastewater utilization: (1) Flowing waste hot water from thermal power plants of constant rate through the solar still, (2) Feeding waste hot water obtained from thermal power plants once a day. Dependence of the distillate output on various operating parameters was investigated.
W84-00476

ENGINEERING MANAGEMENT OF DESALINATION PLANTS IN SAUDI ARABIA USING FUZZY DECISION ANALYSIS,
Riyadh Univ. (Saudi Arabia). Coll. of Engineering.
A. F. Abdul-Fattah.
Desalination, Vol 37, No 3, June 1981, p 343-350, 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Desalination, Desalination plants, Management planning, *Saudi Arabia, Fuzzy set theory.

The fuzzy set theory is used in this analysis to help the decision-makers in selecting the most likely to succeed engineering management strategy for the operation of large desalination plants in Saudi Arabia. Five alternative strategies are suggested for the problem of desalination plants management. Fuzzy set theory and MAFDA computer code are used in the analysis. Fourteen criteria were selected. The final results show that the best solution is to use the computer and simulation strategy, and the second best is to use the local workers who had been trained in foreign countries.
W84-00477

EFFECT OF LIQUID TEMPERATURE ON SPRAY FLASH EVAPORATION,
Kyushu Univ., Fukuoka (Japan). Research Inst. of Industrial Science.
O. Miyatake, T. Tomimura, Y. Ide, M. Yuda, and T. Fujii.
Desalination, Vol 37, No 3, June 1981, p 351-366, 11 Fig, 1 Tab, 5 Ref.

Descriptors: *Desalination, Desalination plants, Spray evaporation, Temperature, *Evaporation, *Distillation.

To complement a previous experimental study of spray flash evaporation pursued at 60C jet inlet temperature, the effect was studied of liquid temperature on the spray flash evaporation by changing jet inlet temperatures to 40 and 80C. From the experimental results, a more general empirical equation suitable for predicting the variation of liquid temperature in the center of jet with residence time was deducted, and the recommendable operating conditions were proposed. Furthermore, an expedient method for prediction of the liquid temperature drop along the length of jet was devised for the recommendable operating conditions. Even at lower liquid temperatures, the spray flash evaporation still has higher evaporation performance and extremely faster evaporation rate than the flash evaporation occurring in other systems.
W84-00478

TEST AND EVALUATION OF 75,000 GALLON PER DAY CRYSTALEX PILOT PLANT.
Avco Systems Div., Wilmington, MA.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-128602, Price codes: A04 in paper copy A01 in microfiche. Completion Report, March 1977. 55p 17 Fig. 4 Tab. 5 Ref. -3255(1) 14-30-3255.

Descriptors: *Desalination plants, *Pilot plants, *Mechanical engineering, *Performance evaluation, *Design criteria, Desalination apparatus, Desalination, Hydraulic engineering, Freezing, Refrigeration, Water treatment, Process control, Evaluation, Flow rates, Design standards, Design flow.

A constructed 75,000 gallon/day (gpd) secondary refrigerant freezing (SRF) plant was moved to the Office of Water Research and Technology's Test Station on the North Carolina coast for testing. The plant was constructed to demonstrate an SRF process which used a non-flammable secondary refrigerant (R-114, dichlorotetrafluoroethane) and incorporated features which would permit construction of transportable packaged plants in capacities up to 100,000 gpd. The plant differed from early comparable size SRF plants in that it used: a smaller pressurized counterwasher than gravity-drained washers, and many elements sized for flows for 125,000 gpd if the wash column and freezer performed appropriately. The overall process of the direct-contact SRF desalting plant is described, along with pilot plant operations and detailed descriptions of the plant equipment and its performance. Technical and process problems occurring during initial operations were resolved as encountered. While an inability for achieving acceptable performance levels in the pressurized counterwasher limited success for demonstrating a reliable economical freezing system, several significant objectives were achieved for continued freeze desalting assessment. Follow-on work will include installing a gravity wash column for continued pilot plant operation. (Zielinski - MAXIMA)
W84-00493

WORLD'S FIRST SOLAR POWERED REVERSE OSMOSIS DESALINATION PLANT,
Water Services of America, Inc., Milwaukee, WI.
W. W. Boesch.
Desalination, Vol 41, No 2, May 1982, p 233-237, 5 Fig.

Descriptors: *Desalination, Desalination plants, *Solar energy, Reverse osmosis.

Reliable water production to meet the drinking needs of small communiities using the technologies of seawater reverse osmosis (RO) and solar photovoltaic systems have been demonstrated. The abundance of sunshine in arid areas makes solar RO particularly viable. Reliable system operation without other power source backup supplies has also been demonstrated. A simple DC power arrangement for the complete system was shown to be effective. This demonstration system is the beginning of more and larger solar powered (RO) desalination systems.
W84-00503

STUDIES ON ALKALINE EARTH SULFITES - III(1). TRANSIENT SOLUBILITIES AND PHASE CHANGES OF CALCIUM SULFITE IN SEAWATER,
A. Cohen, M. Zangen, M. Koenigsbuch, and J. M. E. Goldschmidt.
Desalination, Vol 41, No 2, May 1982, p 215-232, 11 Tab, 4 Fig, 27 Ref.

Descriptors: *Desalination, *Sulphite pretreatment, *Seawater, *Calcium compounds, Alkaline earth sulfites, Calcium sulfite, Corrosion, Pretreatment of water.

Calcium sulfite was sufficiently soluble in seawater of various compositions to allow the use of SO sub 2 for pretreatment of seawater (to prevent corrosion and alkaline scale formation) in desalting plants. The solubility of calcium sulfite, prepared by mixing 0.4M solutions of Na sub 2 SO sub 3 and CaCl sub 2, in natural or synthetic seawater decreases with time and does not reach equilibrium for several weeks. Transient molal solubilities, at 25C after 20 min and 24 h, respectively, are 2.9 and 2.2 in natural seawater, 3.9 and 3.4 in 0.7M NaCl solution. This decrease is due to a gradual transformation, by a slow dissolution-recrystallization process, of a metastable phase of crystalline calcium sulfite into a more stable, less soluble, modifi-

cation observed by X-ray crystallography, scanning electron microscopy and thermal analysis. The addition of Na sub 2 SO sub 3 to natural seawater produced solutions strongly supersaturated with respect to calcium sulfite. These remained stable for extended periods, and were only slowly affected by solid calcium sulfite added later.
W84-00504

EFFECT OF RECOVERY ON DESALINATION OF THE BLACK SEA WATER BY REVERSE OSMOSIS,
Higher Inst. of Chemical Technology, Burgas (Bulgaria). Dept. of Water Technology.
I. Dobrevsky, V. Mavrov, and B. Bonev.
Desalination, Vol 41, No 2, May 1982, p 209-214, 2 Tab, 5 Fig, 2 Ref.

Descriptors: Desalination, Membranes, RO, Ultrafiltration, Reverse osmosis, Cellulose acetate, Tubular membranes, Black Sea, Brines, Pretreatment of water.

The effect of fresh water recovery was studied during Black Sea water reverse osmosis (RO) desalination with cellulose acetate tubular membranes. Two different schemes of brine pretreatment before RO were investigated. Ultrafiltration can be applied as an effective alternative method for Black Sea water pretreatment. Up to 30% recovery, the product flux as well as the salt and the specific ionic rejection are all fairly stable. Special experiments showed that in a stable turbulent regime Ca ions removal from Black Sea water before RO with tubular membranes hold out no technological advantages.
W84-00505

CHLORIDE/SULPHATE EXCHANGE OF ANION RESINS, KINETIC INVESTIGATION, VIII. INFLUENCE OF SOME PHYSICO-CHEMICAL PROPERTIES OF THE RESINS,
Istituto di Ricerca sulle Acque, Bari (Italy).
L. Liberti, R. Passino, and D. Petruzzelli.
Desalination, Vol 41, No 2, May 1982, p 199-207, 3 Tab, 4 Fig, 8 Ref.

Descriptors: *Desalination, Kinetics, Physicochemical properties, Chlorides, Sulphates, Chloride/Sulphate exchange, *Anion resins, *Resins.

Experimental exchange rates for Cl-/SO4- exchange on strictly comparable anion resisn in 0.0006N solution confirm the unfavorable correlation between kinetics and selectivity. Evaluation of the influence of other physico-chemical properties of the resins (i.e. nature of matrix, type of amine, etc.) seems to support the hypothesis that chemical interactions, and not only diffusional effects, in the resin phase play a leading role on rate control. (Balaban-Boston)
W84-00506

PERFORMANCE EVALUATION AND PROCESS DESIGN OF AN ELECTRODIALYSIS PLANT BY OVERPOTENTIAL MEASUREMENTS,
Istituto di Ricerca sulle Acque, Bari (Italy).
R. Passino, C. Marra, A. Rozzi, and G. Tiravanti.
Desalination, Vol 41, No 2, May 1982, p 181-197, 1 Tab, 6 Fig, 18 Ref.

Descriptors: *Desalination, Desalination plants, *Electrodialysis plant, Membrane processes, Overpotential measurements, Ionics Mark III ED Stack.

The Ionics Mark III ED stack was investigated. The experimental techniques used allowed ED plant performance to be evaluated as a series of elementary subsystems; concentration boundary layer over-potentials were measured at different locations along the membrane flow path. The current interruption technique was used in order to calculate inter-facial concentrations and diffusion boundary layer thickness. The dependence was established of concentration polarization on membrane path length; the last membrane sections were strongly polarized even at relatively low operating current densities. A better ED plant design should make use of sequence of stack sections at different applied voltages.
W84-00507

MATHEMATICAL MODEL OF A MECHANICAL VAPOUR COMPRESSION EVAPORATOR. APPLICATION TO SEAWATER DESALTING. PART I - THE MODEL SETTLEMENT,
Institut de Genie Chimique de Toulouse (France).
D. Aussenac, S. Domenech, and M. Enjalbert.
Desalination, Vol 41, No 2, May 1982, p 137-169, 1 Tab, 1 Fig, 14 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, *Vapor compression evaporation, Numerical analysis, Mathematical models.

The performance is analyzed of a mechanical vapor compression evaporator used particularly for the production of fresh water by a process of seawater desalination. The setup of the pilot plant used is described, its performance is analyzed and a simulation mathematical model is established for the system. The exhaustive character of this model leads to a nonlinear system of 215 equations whose numerical analysis and solution are presented.
W84-00508

OPERATION OF MEFF DESALINATION PLANT (MULTIPLE EFFECT FALLING FILM PROCESS),
Toyo Engineering Corp., Tokyo (Japan).
S. Kido.
Desalination, Vol 41, No 2, May 1982, p 127-136, 6 Figs, 3 Ref.

Descriptors: *Desalination, Desalination plant, Desalination plants, *Multieffect distillation, Falling film, *Distillation, Jabal Dhana, Abu Dhabi, United Arab Emirates.

The 2273 cu.m/d MEFF (multiple effect falling film) sea water desalination plant, constructed by Toyo Engineering Corp. in Abu Dhabi, United Arab Emirates, is now in successful continuous operation. The MEFF process consists of evaporators, preheater, condenser and deaerators. Heat exchangers are designed with vertical tubes for heat transfer. Operaiion results have demonstrated excellent production capacity. The vertical condenser of the open air type enables tube maintenance during plant operation.
W84-00509

SHIP-MOUNTED SEAWATER 2500 CU M/D FLASH EVAPORATION PLANT FOR ABU-DHABI. ECONOMICAL DRINKING WATER FOR ARID REGIONS,
Buckau-Walther A.G., Essen (Germany, F.R.). Water Engineering Div.
K. Wangnick.
Desalination, Vol 41, No 2, May 1982, p 171-180, 7 Fig, 1 Tab.

Descriptors: Desalination, Desalination plants, Distillation, Flash evaporation, Ships, Abu-Dhabi, Arabian Gulf, Buckau-Walther(Krupp).

A ship-mounted seawater desalination plant was tranfered to the Water and Electricity Department of the Government of Abu Dhabi on February 6, 1982. This followed a 12-month construction period and two weeks of trials. Named the 'Rumaith', this is the first self-propelled floating seawater desalination plant built fo commercial use. The plant, consisting of a self-propelled pontoon-like hull carrying two centrally positioned desalination units of 1250 cu m each, will supply islands, coastal towns and major construction sites in the United Arab Emirates with drinking water and will also be deployed in the event of breakdown of stationary desalination plants, to provide an emergency water supply and to alleviate plantation water shortages. After handover, the vessel, accepted by German Lloyd for class + 100 A4K, was towed by tug to Abu Dhabi in the Arabian Gulf in 40 days. As general contractor, Buckau-Walther AG had the vessel built by Detlef Hegemann and Co. Industriewerke Unterwesser.
W84-00510

RECENT ADVANCES IN RO AND ED MEMBRANE TECHNOLOGY,
Office of Water Research and Technology, Washington, DC.
M. E. Mattson, and M. Lew.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-129287, Price codes: A03 in paper copy, A01 in microfiche.
Desalination, Vol 41, No 1, April 1982, p 1-24, 8 Fig, 13 Tab, 6 Ref.

Descriptors: *Desalination, Desalination plants, Membranes, *Reverse osmosis, *Electrodialysis, *Reviews.

The potential impact of recent developments in both reverse osmosis and electrodialysis membrane desalting technology is summarized. Particular emphasis is given to the status of advanced technology reverse osmosis membranes with chlorine resistance having single pass seawater desalination capability. Membranes capable of using low operating pressures for brackish water desalting are also reviewed. Results obtained with large prototype reverse osmosis modules and their potential effect on lowering plant capital costs are presented. Possible elimination of acid and use of ultrafiltration as the predominant pretreatment step in seawater desalination plants are also described. Recent developments in the high temperature electrodialysis program for seawater desalting and in the use of newly developed anion membranes for brackish water desalination are reviewed. Potential impacts on future membrane desalination R and D activity are discussed.
W84-00531

WATER, THE ESSENCE OF LIFE - AN INTERNATIONAL CONGRESS ON DESALINATION AND WATER REUSE,
CH2M Hill Southeast, Inc., Gainesville, FL.
O. K. Buros.
Desalination, Vol 41, No 1, April 1982, p 121-125.

Descriptors: *Desalination, *Water reuse, *Reviews, International Congress, Bahrain.

A review of the International Congress on Desalination and Water Reuse which was held in Manama, Bahrain from November 29 through December 3, 1981. This conference was sponsored by the International Desalination and Environmental Association (IDEA) and the State of Bahrain's Ministry of Works, Power and Water. The conference celebrated the 10th anniversary of the founding of IDEA.
W84-00532

RO SEPARATION OF RARE EARTH IONS FROM AQUEOUS SOLUTION BY HYDROUS FE OXIDE - CELLULOSE COMPOSITE MEMBRANE,
Tohoku Univ., Sendai (Japan). Dept. of Science Engineering.
Y. Kurokawa.
Desalination, Vol 41, No 1, April 1982, p 115-119, 2 Tab, 2 Fig, 6 Ref.

Descriptors: *Desalination, Desalination plants, *Reverse osmosis, Membranes, Composite membrane, *Cellulose acetate, Iron oxides, Donnan ion exclusion effect.

The composite membrane was prepared by impregnation of hydrous iron oxide into a porous cellulose acetate membrane which served as a support. The composite membrane looks like a brownish solid solution. It has a magnetic susceptibility of 1.50 x 10 super -5 emu/g. Rejection of inorganic solute was increased by impregnation. The result is to a certain extent interpreted in terms of the Donnan ion exclusion effect.
W84-00533

RELIABILITY OF MSF PROCESSES BASED ON OPERATION HISTORY,
Technology International, Inc., Ames, IA.
I. I. Kutbi, Z. A. Sabri, and A. A. Husseiny.
Desalination, Vol 41, No 1, April 1982, p 81-113, 8 Tab, 15 Fig, 11 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, *Multistage flash, Jeddah I, Reliability, Fault tree analysis.

Reliability of multistage flash (MSF) processes are estimated using time-dependent fault tree analysis of major critical systems. Failure data are obtained from the operation records of Jeddah I since it is one of the oldest plants still in operation in a relatively harsh environment. Industrial failure data are also used to complement historic data. The analysis shows areas where design improvements can be made to enhance MSF processes availability.
W84-00534

THE OPERATION OF SEA WATER DISTILLATION AND PLANTS IN RELATION TO MATERIALS SELECTION,
Ewbank and Partners Ltd., Brighton (England).
R. Heaton, and T. A. Douglas.
Desalination, Vol 41, No 1, April 1982, p 71-80, 1 Tab.

Descriptors: *Desalination, Desalination plants, *Seawater, *Distillation, Materials, Scaling, Additives, Ras Abu Fontas, Qatar, Jeddah, Saudi Arabia, Multistage flash distillation.

Operational experiences are discussed with multistage flash distillation plants using both low and high temperature chemical additive antiscale treatments. The plants concerned are located at Ras Abu Fontas in the State of Qatar and have had generally good service experience; this is compared with acid dosed plants of similar overall design located at Jeddah, Saudi Arabia.
W84-00535

OPERATING EXPERIENCE OF MSF UNITS IN SAUDI ARABIA,
Saline Water Conversion Corp., Jeddah (Saudi Arabia).
N. Nada.
Desalination, Vol 41, No 1, April 1982, p 57-69.

Descriptors: *Desalination, Desalination plants, *Multistage flash distillation, *Scaling, Jeddah, Saudi Arabia, Additives, Acids.

In Saudi Arabia, the largest producer of water by MSF (500 mgd), for scale control 28% of the units use acid and 60% use additive. It is critical to study and modify operating parameters affecting corrosion since life-time can be reduced to 1/3 or 1/4 if not cared for. External aeration should be used with less than 20 ppb dissolved oxygen in the deareator effluent for an acid treated unit. Low CO sub 2 in the decarbonator effluent is recommended to reduce corrosion in the Cu-Ni alloy and unit internals.
W84-00536

EDGE EFFECTS AND ORIENTATION EFFECTS IN ELECTRODIALYSIS,
City Univ. of New York.
L. Qinglin, Y. Fang, and M. E. Green.
Desalination, Vol 41, No 1, April 1982, p 47-55, 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Desalination, Desalination plants, *Electrodialysis, *Membranes, Critical current densities.

Current-voltage curves were measured, and critical current densities (CCD) determined, for several diameters of one cation, and one anion, electrodialysis membrane. The CCD has been found to be a decreasing function of membrane diameter; the results are correlated by assuming that ions are recruited from some distance from the edge of the membrane. Results are adequately correlated if this distance is taken to be 0.75 mm for the cationmembrane, and 0.25 mm for the anion membrane. This distance is the same for NaCl and HCl for both membranes. In addition to these measurements, CCD has been determined as a function of membrane orientation. CCD decreases as the membrane is tilted away from vertical, with the effect marked if the depletion layer is beneath the membrane.
W84-00537

EFFECTS OF SURFACTANTS ON THE HYPERFILTRATION PERFORMANCE OF DYNAMIC MEMBRANES,
Clemson Univ., SC. Dept. of Chemistry and Geology.
R. J. Luppino, and H. G. Spencer.
Desalination, Vol 41, No 1, April 1982, p 33-45, 2 Fig, 7 Tab, 15 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Hyperfiltration, Dynamic membranes, *Surfactants, Zirconium oxide-polyacrylate.

The effects of surfactants on the permeability and the rejections of other solutes during hyperfiltration by zirconium oxide-polyuacrylate dynamic membranes on porous stainless steel tubes were investigated. The hyperfiltration performance was dependent on the type of surfactant and in some cases the effect was dependent on pH. The effects are attributable to the presence of surfactants at the feed-membrane interface and interactions with the membrane. Rejection is significantly increased at a small cost in permeability by the presence of an anionic surfactant. Large permeability declines occur when surfactant-membrane interactions are possible.
W84-00538

AN ANALYSIS OF THE PERFORMANCE OF A SPIRAL-WOUND ULTRAFILTRATION MEMBRANE, WITH A TURBULENCE-PROMOTING NET,
Natal Univ., Durban (South Africa). Dept. of Chemical Engineering.
R. L. C. Flemmer, C. A. Buckley, and G. R. Groves.
Desalination, Vol 41, No 1, April 1982, p 25-32, 1 Fig, 12 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Mathematical models, Spiral wound, Ultrafiltration, Turbulence-promoting net, Gels.

A mathematical model was developed to describe the performance of a spiral-wound ultrafiltration module with a turbulence-promoting net. The model requires that certain constants be evaluated from tests on filtration modules and thereafter a simple relation is available to predict performance at varying concentrations and recirculation rates, under conditions of gel polarization.
W84-00539

MORPHOLOGICAL STUDY OF CELLULOSE ACETATE BENZOATE MEMBRANES BY SCANNING ELECTRON MICROSCOPY,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
M. D. Vyas, and I. C. Mody.
Desalination, Vol 42, No 1, July 1982, p 107-114, 10 Fig, 2 Ref.

Descriptors: *Desalination, *Membranes, Morphology, *Cellulose acetate membranes, Electron microscopy.

A Scanning Electron Microscope study undertaken to develop a morphological model to aid in predicting new membrane structures suitable for reverse osmosis membranes was undertaken. The cellulose acetate benzoate was studied and compared to cellulose acetate membranes.
W84-00616

DESALINATION OF BRACKISH WATER BY ELECTRODIALYSIS,
Central Salt and Marine Chemicals Research Inst., Bhavnagar (India).
W. P. Harkare, S. K. Adhikary, P. K. Narayanan, V. B. Bhayani, and N. J. Dave.
Desalination, Vol 42, No 1, July 1982, p 97-105, 5 Tab, 2 Fig, 2 Ref.

Descriptors: *Desalination, *Membrane processes, *Electrodialysis, Brackish water, Cation, Ion exchange.

The performance of an electrodialysis unit comprising interpolymer type cation and anion-exchange membranes developed in this institute in single-stage and two-stage operation for desalting of brackish waters having different total dissolved solids has been studied, highlighting the energy requirement and pressure drop under different conditions. For higher salinity waters, a two-stage reduction is advantageous with lower power requirements and power index. The results will be useful for design and installation of ED plants in brackish water sectors.
W84-00617

WETTABILITY AND BREAK-UP OF THIN FILMS ON INCLINED SURFACES WITH CONTINUOUS AND INTERMITTENT FEED,
Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.
D. M. Maron, G. Ingel, and N. Brauner.
Desalination, Vol 42, No 1, July 1982, p 87-96, 5 Fig, 15 Ref.

Descriptors: *Desalination, *Thin films, Wetting.

The conditions for complete wettability of dry or wet surfaces and film break-up were studied. The minimum wetting rates and critical rate before break-up were determined with various operation conditions, including liquid properties, temperature level and surface inclination. Two modes of liquid distribution at the top of the surface were considered, continuous and intermittent. The results are compared and discussed with reference to previous studies.
W84-00618

REVERSE OSMOSIS SEPARATION OF INORGANIC SALTS USING POLYVINYLALCOHOL MEMBRANES,
Erlangen-Nuernberg Univ. (Germany, F.R.). Inst. fuer Technische Chemie.
H. N. Chang.
Desalination, Vol 42, No 1, July 1982, p 63-77, 6 Tab, 2 Fig, 27 Ref.

Descriptors: *Desalination, *Membranes, *Reverse osmosis, Separation techniques, Inorganic compounds, Polyvinyl alcohol membrane.

Permeabilities and fluxes of fifty-four mono-, divalent anions and cations of sodium and chloride salts have been tested under experimental conditions of 50 bar and room temperature through asymmetric polyvinylalcohol membranes crosslinked with formaldehyde. The percentage rejections among these salts are: sodium salts of divalent anions (70-80%); chloride salts of divalent cations (30-40%); H sub 2 SO sub 4 (30%); sodium salts of monovalent monoatomic anions, chloride salts of monovalent cations (15-30%); and HCl, HNO sub 3, NaOH, KOH (10-20%). Sodium salts of monovalent polyatomic anions gave higher rejections than those of monovalent monoatomic anions. Higher rejection of divalent anions than that of divalent cations of chloride salts suggests that the membrane surface is negatively charged.
W84-00620

PREPARATION AND PROPERTIES OF A COMPOSITE CHARGED MEMBRANE,
Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Chemical Technology.
D. A. Noordegraaf, C. A. Smolders, R. D. Boer, and D. J. Rimijn.
Desalination, Vol 41, No 3, June 1982, p 249-261, 5 Tab, 5 Fig, 22 Ref.

Descriptors: *Desalination, *Ultrafiltration, Membrane processes, *Membranes, Polyelectrolytes, Composite charged membrane, Poly(styrene sulfonate).

To develop a low pressure desalination membrane with fixed ionic charges, use was made of the normally unwanted crosslinking tendency in preparing the polyelectrolyte poly(styrene sulfonate) by sulfonation of polystyrene. After dipcoating a poly(sulfone) or poly(phenylene oxide) ultrafiltration (UF) membrane with a dilute solution of this

polyelectrolyte in water in the presence of some free sulfuric acid and silversulfate, fixation and cross-linking of the coating polymer took place by a heat treatment. Different membrane properties could be obtained by varying the pore size of the supporting UF membranes, and by variation in the coating polymer (M.W. concentration) and sulfuric acid concentration. Fluxes sometimes decline drastically in comparison with the original pure water flux; salt rejection values (at 1.5 g/l NaCl concentration and 0.5 MPa) never are very high (less than or equal to 60% for monovalent anions). The most important potential application for these membranes lies in their nonfouling properties.
W84-00621

A CONSIDERATION ON FLOW DISTRIBUTION IN AN ION EXCHANGE COMPARTMENT WITH SPACER,
Radiation Center of Osaka Prefecture, Osaka (Japan)
H. Miyoshi, T. Fukumoto, and T. Kataoka.
Desalination, Vol 42, No 1, Jul 1982, p 47-55, 2 Tab, 6 Fig, 6 Ref.

Descriptors: *Desalination, Membrane processes, Ion exchange, Eddy constant, Navier-Stokes equation, *Fluid mechanics.

The flow distribution in an ion exchange compartment with a spacer is necessary to analyze the mass transfer in the compartment. An equation on the flow distribution in the compartment was theoretically derived by substituting the eddy viscosity of the spacer to the Navier-Stokes equation. The values of the eddy constant contained in the eddy viscosity were indirectly measured, and an experimental equation for estimating the eddy constant is given.
W84-00622

THE COURTAULDS DESALINATION PROCESS,
Courtaulds Ltd., Coventry (England).
D. C. F. Pratt.
Desalination, Vol 42, No 1, July 1982, p 37-45, 1 Fig.

Descriptors: *Desalination, *Distillation plants, *Vapor compression, Plastics, Heat transfer, Courtalds process.

The development of a practical form of plastic heat transfer surface is described and reasons are given for adopting a particular type of configuration. The use of this surface to give very low energy vapor recompression desalination is outlined along with the layout of a fullscale distiller unit. Expected energy consumption figures are given.
W84-00623

VERTICAL TUBE FOAM EVAPORATION FOR WATER DESALINATION,
Envirotech-Sephton Development Center, Emeryville, CA.
H. H. Sephton.
Desalination, Vol 42, No 1, July 1982, p 27-35, 4 Fig, 14 Ref.

Descriptors: *Desalination, *Distillation, Vertical tube foam evaporation, Evaporator.

Vertical tube foam evaporation (VTFE) provides a method of enhancing evaporator performance substantially by increasing the brine-side heat transfer coefficient. It reduces the temperature needed to drive evaporation and the energy required; consequently, the evaporation rate of evaporator capacity is increased under constant temperature conditions. VTFE applied to multiple effect evaporators, in evaporate with vapor compression to drive the process and to waste-heat evaporation of aquaious solutions are illustrated by test data obtained with pilot plants operated under realistic process conditions and utilizing full-size distillation tubes.
W84-00624

THE CHANGING FACE OF DESALINATION - A CONSULTING ENGINEER'S VIEWPOINT,
Binnie and Partners, London (England).
F. C. Wood.
Desalination, Vol 42, No 1, July 1982, p 17-25, 3 Tab, 2 Fig, 11 Ref.

Descriptors: *Desalination, Desalination plants, *Distillation, *Reverse osmosis, Solar, *Economic evaluations, Forecasting, Multistage flash.

The present major market for desalting plants will continue to rely mainly upon the proven multistage flash process until local policy dictates a need for resources conservation or the long-term merits of reverse osmosis (RO), as well as its high energy-efficiency, are well established. On the other hand, industrialized, oil-importing countries, with increasing water shortages and environmental contraints, must develop energy-efficient processes for single- and dual-purpose operation as well as improve RO membranes for desalting of seawater. The needs of small-plant users require particular consideration if the simple yet reliable plants which their circumstances demand are to be satisfied. Solar plants are likely to find their initial commercial applications in this market.
W84-00625

THE PURAQ SEAWATER DESALINATION PROCESS,
Puraq Co., New Haven, CT.
L. Lazare.
Desalination, Vol 42, No 1, July 1982, p 11-16, 3 Fig.

Descriptors: Desalination, Seawater, Liquid-liquid extraction, Polymeric solvent, Puraq, Polymers.

The Puraq seawater desalination process is based on the liquid-liquid extraction of product water using a polymeric solvent, custom-synthesized to satisfy a particular set of design conditions, namely maximum seawater temperature and salinity.
W84-00626

TECHNOLOGICAL AND ENVIRONMENTAL ASPECTS OF DESALINATION,
R. S. Silver.
Desalination, Vol 42, No 1, July 1982. p 1-9.

Descriptors: *Desalination, *History, Industrial water social needs, *Social aspects.

The industrial and sociological importance of desalination, and its place in the nexus of chemical engineering are surveyed. The history of its development, particularly in the last two decades, is reviewed, and the risky task of foreseeing the next 20 years in the field is attempted. For this latter task there is a crystal ball provided by the laws of thermodynamics, but unfortunately the crystal view is frequently distorted by inadequate understanding of these principles and their application. A fundamental analysis is given of desalination processes in terms of thermodynamics, demonstrating the interaction between practical necessities and thermodynamic imperatives. It is shown how the implications of this analysis have been confirmed by the history of development, and so suggests confidence in the interpretation for the future. All signals are subject to distortion by noise, and reference is made to the main sources of noise in this subject, which vary from the shrill sounds of the marketplace through the sombre notes of fiscal policies to the cacophony of politics.
W84-00627

ALCOHOL REDUCTION IN BEER BY MEANS OF DIALYSIS,
Wickuler-Kupper-Brauerei K.G., Wuppertal (Germany, F.R.).
H. Moonen, and H. J. Niefind.
Desalination, Vol 41, No 3, June 1982, p 327-335, 3 Tab, 6 Fig, 8 Ref.

Descriptors: *Desalination, *Membrane processes, Dialysis, Hollow fiber membranes, *Beer, Alcohols.

A process to reduce the alcohol content of beer is presented based on the principle of dialysis. Its selectivity is demonstrated by carbohydrate spectra and other analytic data. A large-scale pilot unit, in use for more than one year, is described. The membranes are hollow fibers with a total area of 90 sq m. The unit produces 1,500 /h of dietetic beer, whose alcohol content is reduced by 40%. The performance of the unit and the degree of alcohol reduction can be controlled within narrow limits.
W84-00628

RECYCLING OF DETERGENTS AFTER ULTRAFILTRATION OF CLEANING SOLUTIONS,
Daimler-Benz A.G., Stuttgart (Germany, F.R.).
H. Paul.
Desalination, Vol 41, No 3, June 1982, p 313-325, 1 Tab, 8 Fig.

Descriptors: *Desalination, *Ultrafiltration, Recycling, *Detergents.

Experiments showed that a recycling of detergents after separation by an UF process is possible without any risks to production. Considerable savings in operating costs as well as a simultaneous discharge of the waste water can be expected. As a result of the experience gained, the range of application of membrane technology, in this case UF, has been extended to an important range of application, a fact which is of major importance for the future. Tests with respect to optimizing the recovery of detergent substances by changing the hydraulic values of UF systems are at present being carried out in collaboration with the Institute for Chemical Engineering at Aachen.
W84-00629

BIOTECHNICAL APPLICATIONS OF A PLEATED CROSSFLOW MICROFILTRATION MODULE,
Membrane Filtration Technology, Inc., Rehovoth (Israel).
G. B. Tanny, D. Hauk, and U. Merin.
Desalination, Vol 41, No 3, June 1982, p 299-312, 1 Tab, 10 Figs, 17 Ref.

Descriptors: *Desalination, *Membrane processes, *Ultrafiltration, Pleated crossflow microfiltration module, Low pressure membrane, Microorganisms, Protein separation, *Cheese, Whey, Butter fat.

The use of a pleated, tangential flow microfiltration module was investigated in the context of 3 areas of biotechnology: (a) industrial scale harvesting of microorganisms; (b) diafiltrative separation of a low molecular weight protein, from a homogenate of soft animal tissue; and (c) the removal of fat and casein particles from cheese whey prior to concentration of the whey by ultrafiltration. In all applications, low pressure membrane microfiltration technology can be used to either improve the overall efficiency and performance of centrifugal separations or to replace them entirely. In the case of prefiltration of cheese whey, significant improvement was achieved both for the recovery of butter fat as well as increased UF membrane flow rates in the concentration step.
W84-00630

SIMULTANEOUS AUTOMATIC MEASUREMENT OF SALT AND WATER FLUXES THROUGH A CHARGED MEMBRANE,
Rouen Univ., Mont-Saint-Aignan (France). Lab. de Chimie Macromoleculaire.
C. Ripoll, M. Labbe, L. Lavielle, and E. Selegny.
Desalination, Vol 41, No 3, June 1982, p 289-298, 1 Tab, 5 Fig, 8 Ref.

Descriptors: *Desalination, *Membrane processes, Feedback controled system, *Sulfonated polyethylene membrane, Cations.

A feedback controlled system is proposed which maintains constant concentrations of solutions on both sides of a membrane. The constancy is obtained by feeding each half cell with amounts of suitable adjusting solutions. Both Salt flux, J sub s

and water flux, J sub w are deduced from addition rates. It is of special interest that the system allows simultaneous measurement of both fluxes, in absolutely controlled steady state conditions. The system is analyzed on the basis of the methods of automatics. The reliability of the controlling device has been tested by comparing the value indicated for known fluxes imposed through capillaries simulating a membrane. Data are given for a sulfonated polyethylene cation exchange membrane.
W84-00631

THE PROSPECTS OF WATER REMOVAL BY HYPERFILTRATION USING THIN FILM COMPOSITE MEMBRANES,
Danske Sukkerfabrikker, Nakskov. Driftteknisk Lab.
W. K. Nielsen, and S. Kristensen.
Desalination, Vol 41, No 3, June 1982, p 277-288, 1 Tab, 9 Fig, 7 Ref.

Descriptors: *Desalination, *Membranes, *Hyperfiltration, Plate-and-frame system, Thin-film composite membrane, Orange juice concentration.

A thin film composite membrane (HR) was superior to CA membranes in its pure water flux and salt rejection, rejection of low molecular weight organic compounds, temperature and pH stability, and stability against chemicals. The membrane was developed for water desalination, but its greatly improved properties increase the applicability of hyperfiltration for water removal in many fields. To benefit from HR membrane superiority, the plate-and-frame system was also improved. Experiments with hyperfiltration using HR membranes at a temperature as high as 80C were carried out on thin juice from the beet sugar industry. A pilot plant working at 30 bar and 80C for one month gave promising results in spite of the extreme hyperfiltration operating conditions. Promising results were obtained with the HR membranes working at 60 bar and 60C on fermentation broth from yeast production. For these applications, the possibilities of using strong acid and strong alkaline cleaning agents were useful. Preliminary experiments on hyperfiltration of orange juice indicated that the HR membranes have a greatly improved rejection of aroma carrying compounds, thus improving the possibilities of using hyperfiltration for orange juice concentration.
W84-00632

LETTER TO THE EDITOR ON PAPER PUBLISHED IN DESALINATION VOL 41(1982) 57-69 BY N.NADA: OPERATING EXPERIENCE IN MSF UNITS IN SAUDI ARABIA,
CIBA-GEIGY Plastics and Additives Co., Manchester (England). Industrial Chemicals Div.
D. G. Addenbrook.
Desalination, Vol 41, No 3, p 337.

Descriptors: Desalination, Distillation, MSF, Scale control, Additive vs acid treatment, Belgard EV, Saudi Arabia.

Dr. Addenbrook maintains that, contrary to the paper by Nada, Belgard EV performs successfully and cost-effectively and this is described by R. Heaton and T. A. Douglas in Desalination 41 (1982) 71-80. (The operation of seawater distillation plants in relation to materials selection).
W84-00633

PROCEEDINGS OF THE SYMPOSIUM ON MEMBRANE TECHNOLOGY IN THE 80'S, YSTAD, SWEDEN, SEPTEMBER 29 - OCTOBER 1, 1980.
Lund Univ. (Sweden).
B. Hallstrom, and M. Balaban.
Desalination, Vol 35, Vols 1/2/3, December 1980, 444 p.

Descriptors: *Membranes, *Desalination, Dairy industry, Chemical industry, Pharmaceutical industry, Biotechnology.

Volume containing the Proceedings of the Symposium on Membrane Technology in the 80's with the participation of scientists and engineers in the field. This volume contains 29 papers on membrane technology for desalination and other industries.
W84-00687

SYNTHETIC MEMBRANES: STATE OF THE ART,
Max-Planck-Inst. fuer Biophysik, Frankfurt am Main (Germany, F.R.).
W. Pusch, and A. Walch.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 5-20, 2 Tab, 14 Fig, 46 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, *Review, Reverse osmosis, Electrodialysis.

Synthetic membranes are used for a great variety of separation processes such as dialysis, electrodialysis, hemodialysis and hemofiltration, ultra- and hyperfiltration, and pervaporation, where the process is generally designated according to the applied driving force such as a concentration, electrical potential, or pressure difference, respectively, across the membrane. A great deal of work was spent during the last 25 years for the development of the best possible membranes using almost every available polymeric material. At the beginning of membrane research, natural polymers such as cellulose and cellulose derivatives were essentially employed for the preparation of appropriate membranes such as collodion and cellulose acetate, for instance. These polymeric materials were rediscovered for the preparation of desalination membranes installed into hyperfiltration modules for the production of fresh water from brackish and seawater. In this connection, new membrane structures and configurations were designed besides the common homogeneous flat sheet membrane in order to meet the demands of high flux and high packaging density of a corresponding membrane module. With respect to an improved packaging density, spiral-wound, tubular, capillary, and hollow-fine fiber modules were designed in addition to the classical plate and frame module. Moreover, asymmetric and so-called composite membranes were developed to generate high flux membranes possessing the same selectivity as the corresponding homogeneous ones. Concurrently with the development of new membrane structures and configurations, new polymeric materials such as polyamides, polymides and polybenzimidazolone were cast into membranes improved transport properties and chemical resistivity.
W84-00688

OVERVIEW OF THEORIES FOR WATER AND SOLUTE TRANSPORT IN UF/RO MEMBRANES,
Technical Univ. of Denmark, Lyngby. Inst. for Kemindustri.
G. Jonsson.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 21-38, 7 Fig, 15 Ref.

Descriptors: *Desalination, Desalination plants, Reverse osmosis, Ultrafiltration, Membranes, *Solute transport.

The applicability of various models for the transport of water and solute in UF/RO membranes is briefly outlined. The selectivity of various solutes in ultrafiltration (UF) and reverse osmosis (RO) is discussed.
W84-00689

DEVELOPMENT OF NEW MEMBRANES,
Forschungsinstitut Berghof G.m.b.H., Tuebingen (Germany, F.R.).
H. Strathmann.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 39-58, 14 Fig, 29 Ref.

Descriptors: *Review, *Desalination, Desalination plants, *Membranes, Hyperfiltration, Ultrafiltration, Polymers, Cellulose acetate, Polysulfone, Polyamide.

Asymmetric membranes made from various polymers, such as cellulose acetate, polysulfone, polyamide, etc. by a phase inversion process are widely used today in ultra- and hyperfiltration. In spite of their good filtration properties, these membranes have certain short-comings as far as their selectivity and chemical stability are concerned. Considerable effort has therefore been spent in recent years to develop new membranes with better separation characteristics and better overall properties tailor-made for special applications. For desalination of sea- and brackish waters, e.g., composite membranes with better chemical stability and higher fluxes and salt rejection have been developed. For the treatment of certain industrial effluents, liquid membranes with carrier facilitated transport properties for certain metal ions are available today. Membrane preparation techniques are no longer limited to the phase inversion process; track etching procedures, plasma polymerization and radiation induced grafting are used today to produce membranes for various applications. Recent developments in the preparation techniques of membranes and membrane materials are reviewed.
W84-00690

CONCENTRATION POLARIZATION AND FOULING,
Lund Univ. (Sweden). Food Engineering Div.
E. Matthiasson, and B. Sivik.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 59-103, 3 Tab, 7 Fig, 143 Ref.

Descriptors: *Membranes processes, *Polarization, *Desalination, Seawater, Membranes, Fouling.

Concentration polarization is often the reason for the serious limitation of the membrane processes due to its negative influence on the transmembrane flux. Many theoretical studies on this polarization phenomena have resulted in mathematical models for concentration polarization. In most of them, solutions are sought for the coupled nonlinear system of the equations of continuity and motion. Each of these solutions makes use of some assumptions in order to simplify the equations which represent the phenomenon. Different kinds of flow systems have been constructed in order to reduce the concentration polarization. The aim of these flow systems has mainly been to improve the mass transport from the membrane surface back to the bulk solution. Fouling often is a result of concentration polarization, but can also have other reasons. Unveiling the basic mechanisms of fouling attracted little attention until the late seventies, when for example, fouling of an RO seawater desalination membrane could be subdivided into four consecutive steps. Studies of the chemistry and physics of fouling were performed on whey and revealed in close detail some of the responsible phenomena.
W84-00691

INTERFACIAL PHENOMENA - BIOADHESION AND BIOCOMPATIBILITY,
Lund Univ. (Sweden). Food Technology Div.
K. Larsson.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 105-114.

Descriptors: Synthetic membranes, *Fouling, *Membrane processes, Bioadhesion (fouling), Biocompatibility.

The physical-chemical interaction between components of biological fluids and solid materials is considered with regard to performance of synthetic membranes. The possibilities to reduce irreversible bioadhesion (fouling) of membranes, and to achieve biocompatibility, are discussed on the basis of the theory of colloidal adhesion, recent knowl-

edge on so-called hydration forces, and experiences with biomaterials.
W84-00692

ULTRAFILTRATION AT LOW DEGREES OF CONCENTRATION POLARIZATION: TECHNICAL POSSIBILITIES,
Lund Univ. (Sweden). Food Engineering Div.
M. Lopez-Leiva.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 115-128, 2 Tab. 9 Fig, 11 Ref.

Descriptors: *Desalination, Desalination plants, *Membranes, Ultrafiltration, *Concentration polarization, Plate-and-frame membrane.

The phenomenon of concentration polarization (CP) produces well known deleterious effects in ultrafiltration (UF), the most important being the many-fold diminishing of trans-membrane flux. Classical methods used to decrease this negative influence have made use of either a turbulent flow or a high shear stress laminar flow past the membrane. In both cases the liquid is recirculated through the UF module until the desired degree of concentration is obtained. The same type of flow can be obtained either by moving the membrane in relation to the liquid or by moving a surface parallel to the membrane. Here the velocity of the fluid across the module is irrelevant and consequently it can be set according to the degree of concentration required. Two modules working with this principle are presented. One of laboratory-scale size is composed of a pair of concentric cylinders of which the inner one, carrying the semipermeable membrane, is rotatable. The other module, of around 0.6-sq m membrane area, is of the rotary 'plate-and-frame' type. Energy consumption curves for each module as well as their performance in the ultrafiltration of BSA solutions and milk are presented.
W84-00693

FOULING OF ULTRAFILTRATION MEMBRANES: LATERAL MIGRATION AND THE PARTICLE TRAJECTORY MODEL,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
G. Green, and G. Belfort.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 129-147, 8 Fig, 48 Ref.

Descriptors: *Membranes, *Ultrafiltration, Fouling, Colloids, Lateral migration, *'Flux-paradox' problem.

Lateral migration theory is used both to explain the 'flux-paradox' problem for colloidal suspensions and as part of the standard filtration theory for calculating permeation flux as a function of time. Particle trajectory analysis is used to model the physics of colloidal fouling in tangential flow ultrafiltration. A method is also suggested on how to incorporate trajectory analysis into the standard filtration theory. The theoretical results are compared with experiments from the literature and from the author's laboratory.
W84-00694

EVALUATION OF STATIC MIXERS AS CONVECTION PROMOTERS IN THE ULTRAFILTRATION OF DAIRY LIQUIDS,
Nederlands Inst. voor Zuivelonderzoek, Ede.
J. Hiddink, D. Kloosterboer, and S. Bruin.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 149-167, 6 Tab, 6 Fig, 17 Ref.

Descriptors: *Membranes, *Ultrafiltration, *Dairy industry, Static mixer, Milk.

The efficiency was determined of various types of static mixer (variants of the Kenics type) for enhancing the permeate flux in ultrafiltration plants. A theoretical analysis of the transport phenomena that occur in the laminar-flow region in a tube divided into two half-cylindrical channels, showed that the mass transfer coefficient increased by a factor 1.95 as compared with that in a cylindrical tube. The increase in permeate flux obtained in the experiments, amounted to a factor 2.9. This extra effect should be attributed to rotation of the liquid and changes in the direction of rotation, caused by the static mixers. At equal energy input levels, approximately equal permeate fluxes were achieved in both the laminar-flow and the turbulent-flow region, whether static mixers were used or not. The types of static mixer tested did little to improve the energy efficiency in ultrafiltration plants under the prevailing conditions.
W84-00695

MEMBRANE PROCESSES IN THE DAIRY INDUSTRY,
Nederlands Inst. voor Zuivelonderzoek, Ede.
R. De Boer, and J. Hiddink.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 169-192, 1 Tab, 13 Fig, 44 Ref.

Descriptors: *Membranes, *Ultrafiltration, *Reverse osmosis, Milk, Whey, Cellulose acetate, *Dairy industry.

From the increase in the ultrafiltration (UF) and reverse osmosis (RO) membrane surface, considerable progress has been made in the dairy industry during the last 10 years. This development will continue in the eighties. The increase in energy prices wil favour the development of RO, not only for whey but, due to an increase permeate flux, also for milk. In addition to concentration before transport to centralized plants the manufacture of milk products from concentrated milk will be also of interest. A developing whey protein market for products with 35%, 60% and 80% protein and a more stringent pollution control, which will force the dairy industry to process their whey, will influence th application of UF positively. The use of UF for the manufacture of a variety of cheeses from fresh to semi-hard cheese is a possibility now. An important point in this development is that the manufacturers of equipment offer complete production lines. A by-product of UF is the permeate with its high lactose content, and possibilities for profitable use have recently become available. To achieve a higher permeate flux pretreatment of the starting liquid has to be applied in many cases. Fouling of the membranes is particularly caused by calcium phosphate. Proteins play some role. More research is necessary before these phenomena are fully understood. Not only the pretreatment but also the bacteriological aspects are a specific problem for the dairy industry. Especially in cases of RO at 30C - the maximum process temperature for cellulose acetate membranes - continuous attention to cleaning and disinfection is necessary.
W84-00696

PRODUCTION OF WHEY PROTEIN CONCENTRATES WITH HIGH SOLIDS CONTENT,
Pasilac A/S, Silkeborg (Denmark).
J. Rubin.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 193-199, 4 Tab, 3 Fig.

Descriptors: *Ultrafiltration, *Dairy industry, Milk, Membranes, *Whey, Proteins.

Ultrafiltration is very useful in production of whey protein powders. The protein concentrates obtained by this process seldom have a solid content higher than about 20%, and it is very difficult to evaporate, especially concentrates with relatively high protein contents. This means that a large part of the whey protein concentrates produced today is spray dried directly which in turn is costly and may give troubles with e.g. light and bulky powders. At experiments on a DDS 20-cm laboratory module it was possible to concentrate whey protein concentrates with about 80% protein in solids to more than 35% total solids. A number of hyperfiltration and ultrafiltration membranes were tested at temperatures up to 50C and varying pressures. Using ultrafiltration membranes further gave an increase in the relative protein content of the concentrate. Results obtained on the lab-module were later confirmed on a DDS/Pasilac pilot plant with a 7 sq m 30-cm module equipment with GR 81P membranes. The pilot plant was operated both in batch and in continuous mode. The final concentrates could be 'pasteurized' at 66C for 15 seconds but blocked the pasteurizer at 69C. Spray drying of the product using a nozzle atomizer was uncomplicated and gave a relatively high bulk density of the resulting powders.
W84-00697

CONCENTRATION OF RAW WHOLE MILK BY REVERSE OSMOSIS AND ITS INFLUENCE ON FAT GLOBULES,
Nederlands Inst. voor Zuivelonderzoek, Ede.
R. De Boer, and P. F. C. Nooy.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29-Oct. 1, 1980), p 201-211, 5 Tab, 3 Fig, 11 Ref.

Descriptors: *Reverse osmosis, Tubular reverse osmosis, *Dairy industry, *Milk, Filtration, Butter.

Raw whole milk was twofold concentrated in a tubular reverse osmosis (RO) system. Methods of preventing damage being caused to the milk fat globules were investigated. Fat damage - checked by the BDI method and homogenization degree - is induced particularly by the normal pressure relief valves. The use of a capillary tube, pressureless removal (dead-end filtration) or cooling of the milk before the normal pressure relief valve below 7C prevented damage to the milk fat. This last method can be applied in a continuous process as well as in a batch process. The twofold concentrated milks derived from the various procedures were stored at 4C during two to three days, no increase in BDI value took place. Cultured butter made from concentrated milk had a higher diacetyl content and a more sweet and acid flavour (yoghurt-like) than a control butter, which is probably the outcome of a higher solids-not-fat content. No rancid off-flavours could be detected in the butter made from concentrated milk, while during cold storage no development of off-flavours of an oxidative character took place. In addition to the product quality, attention was also paid to the lay-out of a RO installation based on the principle of dead-end filtration.
W84-00698

PRODUCTION AND PROPERTIES OF YOGHURT AND YMER MADE FROM ULTRAFILTRATED MILK,
Statens Forsoegsmejeri, Hilleroed (Denmark)
G. Mogensen.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept 29-Oct 1, 1980), p 213-222, 3 Tab, 7 Fig.

Descriptors: *Ultrafiltration, *Dairy industry, Milk, Yoghurt, Ymer.

Yoghurt and Ymer are examples of fermented products which are concentrated in solids nonfat (SNF). Ymer is a Danish dairy product which is heavily concentrated. According to Danish legislation it must contain at least 6% milk protein and at least 11% SNF. Originally this concentration was achieved by draining off 50% whey after fermentation. The development of ultrafiltration (UF) to an industrial scale opened new possibilities to facilitate standardization of SNF, increase product yield and rationalize the production. The chemical composition of ymer made from ultrafiltrated milk differs, however that prepared in the traditional way. Presumably due to the increased content of calcium and phosphorus, UF-ymer is liable to develop a brittle consistency just as the flavour is changed unfavourably. Research has shown that the retention of calcium and phosphorus is affected by the heat treatment of the milk prior to UF and

the temperature at which the milk is ultrafiltrated. The influence on product consistency is rather negligible and the small decrease in calcium retention at lower filtration temperature could not compensate for the decrease in filtration capacity. Because of the changed chemical composition of the UF-ymer, the manufacturing technology has to be changed.
W84-00699

OVERVIEW OF CONCENTRATION POLARIZATION IN ULTRAFILTRATION,
Agricultural Univ., Wageningen (Netherlands). Lab. of Process Engineering.
S. Bruin, A. Kikkert, J. A. G. Weldring, and J. Hiddink.
Desalination, Vol 35, Nos 1/2/3, December 1980 (Comprising the Proceedings of the Symposium on Membrane Technology in the 80's, Ystad, Sweden, Sept. 29 - Oct. 1, 1980), p 223-242, 17 Fig, 53 Ref.

Descriptors: *Ultrafiltration, Concentration polarization, Milk, Whey, *Dairy industry.

Concentration polarization mechanisms are briefly outlined. A morphological analysis of ways to prevent the detrimental influence on membrane fluxes is given. The potentials of these different approaches are analysed and some examples of module designs resulting from the various approaches are given. Particular emphasis is given to a study of the physical-mechanical properties of the gel layer in the ultrafiltration of milk whey in a rotating ultrafiltration module.
W84-00700

3B. Water Yield Improvement

HYDRO STUDIES IN GREENLAND,
Greenland Technical Organization, Copenhagen (Denmark).
H. C. Langager.
International Water Power and Dam Construction, Vol 35, No 2, p 43-45, February, 1983. 2 Fig.

Descriptors: *Hydroelectric power, *Planning, *Water resources development, Greenland, Glaciers, Runoff, Snow melt, Melting.

Intensified energy planning indicates that hydropower is the most favorable alternative to imported oil as an energy source for Greenland. The country's current energy supply situation is reviewed, and a new energy plan prepared by the Ministry of Greenland in 1981 is summarized. Details are given of the quantities of hydropower which could be exploited and of current investigations concerning the hydrological basis for exploitation. Current hydrological and glaciological investigations aim to define the resource at a particular level of certainty. Not only the ice mass balance is of interest, but also the dynamic condition, as the runoff pattern has changed considerably because of the ice front back melting. The final layout with dam levels, power station elevation, mechanical and electrical equipment will depend on marketing conditions and the type of financing available. The entire project will be evaluated with the energy plan in connection with coal- and oil-based energy production. An example of a site for a potential powerplant subject to comprehensive investigations is near the town of Jakobshavn where the inlet of Pakitsup ilordlia is situated, 35 km to the north. Studies have indicated the natural lakes which might be used as reservoirs, potential dam locations and potential waterways with power station locations. The basin itself has uncertain inland ice limitations. (Baker-FRC)
W84-00393

LARGE SCALE DEW COLLECTION AS A SOURCE OF FRESH WATER SUPPLY,
Florida Univ., Gainesville. Dept. of Mechanical Engineering.
A. K. Rajvanshi.
Desalination, Vol 36, No 3, March 1981, p 299-306, 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Water supply, *Condensation, Potable water, *Dew, Moisture.

A scheme for large-scale dew collection as a source of fresh water supply is outlined. The scheme envisages bringing cold seawater (5C) from about 500 meters depth and about 5 km from the shore, in 4, 1.22-m diam plastic pipes. It then passes through a heat exchanger field with an area of 129,000 cu m (1,390,000 sq ft) where it condenses 643 cu m of dew over the 24-hour period. The pumping of seawater from the sea and through the field is accomplished by three 200-kW wind machines. Technical and economical feasibility of the scheme is analyzed and the possibility of marine culture as a source of food is explored. The present scheme is economically not feasible as compared to a reverse osmosis facility of equivalent capacity.
W84-00469

GROUNDWATER SPRINGS TO CAPE VERDES' AID.
World Water, Vol 5, No 12, p 32-33, December, 1982.

Descriptors: Water resources development, *Groundwater, *Developing countries, *Cape Verde, Faja Tunnel, Tunnels, Water distribution, Wells.

Groundwater supplies are being developed in the Cape Verde archipelago, which has virtually no surface waters and is subject to severe droughts. In addition to many wells being drilled, the 2200 m Faja tunnel, scheduled for commissioning in 1985, will carry groundwater by gravity flow from the foot of Monte Gordo to an agricultural area. Electrical and hand pumps are being used. Two wells equipped with wind-powered generations have been installed. (Cassar-FRC)
W84-00585

3D. Conservation In Domestic and Municipal Use

WATER MANAGEMENT INITIATIVES IN THE COMMONWEALTH,
G. M. Lovejoy, III.
Water/Engineering and Management, Vol 130, No 3, p 30-32, March, 1983. 2 Tab.

Descriptors: *Water management, *Water shortage, *Industrial water, *Massachusetts, Water supply, Water demand, Financing, Water conservation, Legislation, Municipal water, Prices, Water rates, Water distribution, Water treatment.

Although Massachusetts has an average annual rainfall of 46 inches, water shortages occur in some sections of the state during dry periods as a result of mismanagement. A comprehensive water management and protection bond program, Chapter 286 of the Acts of 1982, signed by the governor on July 10, is designed to expand current programs and create new ones. Most of the programs are matching programs. All communities must devise a comprehensive water resource management plan. In case of water emergency, a community applies to the state for Chapter 40 approval, which provides powers to enforce water conservation measures, giving priority to water for drinking and fire protection at the expense of manufacturing. Of the total $357.5 million program, $205 million is allocated to publicly owned wastewater treatment facilities and sewers and $60 million to leak detection and rehabilitation of water supply systems. Water management methods for several of the state's communities include increased water rates and use of a flat rate instead of block rate. As a result, industry has initiated water conservation procedures. (Cassar-FRC)
W84-00483

SUMMARY REPORT ON DROUGHT PLANNING BY COMMUNITY WATER SYSTEMS.
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
April 1982. 33 p, 5 Fig, 1 Tab, 4 Append.

Descriptors: *Drought, *Water deficit, *Water shortage, *Urban watersheds, *Reservoir storage, *Water supply, Water level recorders, Water table decline, Water table fluctuations, Water conservtion, Planning, Resources development.

Precipitation during the summer and fall of 1980 in the Southeast area of New York State was substantially below normal and resulted in what has become known as the drought of 1980-81. Total precipitation for 1980 averaged 36.86 in., a deficit of about 8 in. from the mean of 44.93 in. Subsequent studies found that emergency sources were, in general, readily available for most community water systems with the exception of the New York City system and systems in Westchester and Rockland Counties. In addition, New York City made significant conservation efforts which resulted in an overall reduction in water usage of more 200 mgd. Westchester County, in which 79% of the population depends on New York City's reservoir system, has very few usable emergency sources and, therefore, must rely primarily on reducing water usage during periods of drought. In Rockland County, excessive releases from Lake DeForest can be prevented by new opeating regulations. Recommendations for suppliers of water are: (1) water source level monitoring; (2) reservoir volume measurements; (3) new source development; (4) metering of community water systems; (5) emergency source sampling program; (6) emergency source construction or rehabilitation; and (7) emergency equipment stockpile improvement. Additional recommendations are made for regional water management. (Garrison-Omniplan)
W84-00500

3E. Conservation In Industry

REUSING COOLING WATER IN AN ELECTRIC POWER PLANT,
Burns and McDonnell, Kansas City, MO.
W. P. Grobmyer, W. J. Wilson, J. F. Hancock, and M. L. Kurtz.
Journal of the American Water Works Association, Vol 75, No 3, p 119-123, March, 1983. 3 Fig, 2 Tab.

Descriptors: *Cooling water, *Industrial wastewater, *Zero discharge, *Water reuse, Powerplants, Wastewater treatment, Water conservation, Landfills, Deerhaven Station, FLorida, Water quality control, Dissolved solids, Brines.

The Deerhaven fossil fuel-fired generating station, near Gainesville, Florida, has achieved zero waste discharge by reusing cooling water treated by a front-end process. This uses a two-stage lime-soda softening process. In the first stage lime is used to precipitate bicarbonate alkalinity, Mg, and silica at a pH of 11.2-11.4. In the second stage soda ash and carbon dioxide are added to remove Ca and remaining silica. Sludge is treated with potato starch and polymer. The front-end method was chosen after a side-stream technique proved infeasible. During the first year of operation the average effluent contained 15 mg per liter Ca as CaCO3 and 2-3 mg per liter silica. This effluent quality allows 50 cycles of concentration and reuse. Liquid waste is treated in a vapor compression evaporator and spray dryer, and the residue is placed in a clay-lined landfill. The zero discharge policy has decreased the quantity of groundwater taken from the Floridan Aquifer and has reduced damage to the environment downstream of the former waste discharge. (Cassar-FRC)
W84-00386

WATER REUSE AND RECYCLING IN THE FOOD PROCESSING INDUSTRY,
Montgomery (James M.), Inc., Walnut Creek, CA.
L. L. Russell, K. H. Conarroe, C. F. Creson, J. Keller, and L. Esvelt.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125137, Price codes: A15 in paper copy, A01 in microfiche. Technical Report RU-82/13, July 1983. 345 p, 40 Fig, 55 Tab, 126 Ref, 6 Append. OWRT C-90180-R (No 9416)(1), 14-34-0001-9416.

Descriptors: *Food processing industry, *Food-processing wastes, *Industrial wastewater, Indus-

trial water, Reclaimed water, Wastewater renovation, Process water, Recirculated water, Water use, *Water reuse, Wastewater, Health effects.

The potential for water reuse and recycle in each of the major water-using segments of the food industry was evaluated, and projections made for the 1985 and 2000 year water withdrawals in each of the segments with the implementation of water reuse and recycle. The geographic potential for water reuse and recycle was determined in each of the Water Resource Council subregions by past water withdrawals for food processing water availability and types of food processing within the subregion. Product contamination and its impact on the health of the consumer are the major concern in water reuse and recycle in food processing. The potential for reducing product contamination discussed in the report involves the development of water quality criteria for water reuse and recycle in food processing and the evaluation of suitable products and processing operations which will eliminate or reduce contamination resulting from water reuse and recycle prior to final processing operations.
W84-00446

WATER MANAGEMENT INITIATIVES IN THE COMMONWEALTH,
For primary bibliographic entry see Field 3D.
W84-00483

3F. Conservation In Agriculture

CROP YIELD AS AFFECTED BY SPATIAL VARIATIONS OF SOIL AND IRRIGATION,
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.
A. W. Warrick, and W. R. Gardner.
Water Resources Research, Vol 19, No 1, p 181-186, February, 1983. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Crop yield, *Irrigation, *Soil properties, Spatial variation, Monte Carlo method, Costs.

Crop yield is calculated for varying uniformities of seasonal available water. The variation is a consequence of both irrigation and soil heterogeneity. Analytical expressions and Monte Carlo simulations are used to calculate yields for an assumed linear response function. A comprehensive table from the Monte Carlo simulations includes results for 50, 100, and 200% of the water necessary for maximum yield. These are collated with five uniformities and three levels of effective available water. Uniformities of water are expressed as coefficients of variation ranging from 0 to 2. Variations in either irrigation or soil uniformity change the results, but irrigation uniformity is likely the more important, especially for surface systems. The effect of taking the two distributions--for irrigation and soil-- to be correlated does not affect results greatly. When only cost of water is considered, the marginal rate of return is verified to be a maximum for smaller operations. (Author abstract)
W84-00402

BURIED TREASURES OF THE HIGH PLAINS,
Camp, Dresser and McKee, Inc., Austin, TX.
For primary bibliographic entry see Field 4B.
W84-00482

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SMALL HYDRO MAY HELP CZECHOSLOVAKIA'S NEEDS.
International Water Power and Dam Construction, Vol 35, No 2, p 45-56, February, 1983.

Descriptors: *Powerplants, *Hydroelectric power, *Water resources development, *Planning, Czechoslovakia, Energy, Economic aspects, Water demand.

A survey conducted by the Czechoslovak Ministry of Energy has determined that 11 TWh could be generated if all the feasible small scale hydro sites were to be exploited in the country. However, the planning difficulties of constructing and equipping these stations may prove to be too large. Currently small-scale hydro stations provide 3.7 GWh of energy every year to the Czechoslovakian economy, accounting for about 5% of all the country's hydropower output. The basic principles of long-term mini-hydro development were approved by the government in 1979, and practical strategies have since been detailed in a number of government decrees, calling on local councils to investigate the options of water power resources within the area, with particular reference to locations where existing dams, reservoirs and weirs favor the installation of mini-hydro equipment. Credit terms made available are highly favorable for new developments. Even so, little has been done so far. Many local councils feel that the yield of mini hydro stations is so modest, and the profit so small, that it is not worth their while to invest time or capital on the sites. Others are wary of the duties involved. The most important deterrent is that there are no standard ranges of turbine or generator units readily available on the Czechoslovak market. The units now operating are invariably one-off designs which require the attention of a local enthusiast to continue functioning. (Baker-FRC)
W84-00410

HYDROPOWER PROSPECTS FOR SPAIN,
International Water Power and Dam Construction, Vol 35, No 2, February, p 24-27, 1983. 4 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Water resources development, *Dam construction, *Planning, Spain, Floods, Drought.

The first socialist government in Spain for more than 40 years is making plans to accelerate its water control and hydropower program and strengthen the plans it inherited from the previous leadership to extend irrigated areas and invest more capital in dam building. A greater use of water resources and a substantial increase in Spain's new Plain Hidrologico Nacional covering the period between 1982 and 1986 are part of the plan. The drought over the past 3 years indicated severe need for water reserve development in the southern part of the country. The most urgent sections of the current plan deal with the south of Spain, the Guadalquivir river basin, and area of the Guadina river. The general outline of the plan is that Spanish territories should yield another 14,000 cubic meters/year of water to be regulated, which would mean that some 60% of the natural water resources would be controlled. Dam reservoir capacity would have to be raised from the present 46065 cubic hm to 76000 cubic hm. Much work is needed in the mountainous areas of the Iberian Peninsula to ensure that drought conditions can be withstood, and to limit the flash floods, which caused worse damage in the Pyrenees than the Valencia region. (Baker-FRC)
W84-00411

THE HYDRO POTENTIAL OF AUSTRIA,
Oesterreichische Elektrizitaetswirtschafts A.G., Vienna.
A. Gotz, and G. Schiller.
International Water Power and Dam Construction, Vol 35, No 2, February, p 27-30, 1983. 1 Fig, 5 Tab.

Descriptors: *Hydroelectric power, *Water resources development, Austria, Water management, Powerplants, Planning.

Definitions and limitations of surveys of the hydropower potential of Austria are reviewed. The various contrasting characteristics of run-of-river and reservoir-based plants are described. Streams with an annual mean water flow of less than 1 cubic meter/sec were disregarded in the survey. Currently 52% of the exploitable energy potential is already being used, 8% is still being developed and 40% is still only planned. The Danube catchment area represents by far the greatest potential of 21,685 GWh/year. The Danube alone has a potential of 15,539 GWh/year of which 75% is already either being produced or being worked on. The total exploitable potential is viewed as 54,700 GWh/year. The extent of current exploitation is highest in the Upper Austria area as the large rivers have already been exploited such as the Danube, the Inn and the Ems, and the Traun is under development. After this come Lower Austria and Vorarlberg at 68%, Tyrol 44% and the Steiermark at 41%. To achieve the maximum development/potential, large sections of the Austrian water network would remain free of energy production developments. (Baker-FRC)
W84-00412

DISCUSSION: 'OPTIMAL RESERVOIR MANAGEMENT AND CROP PLANNING UNDER DETERMINISTIC AND STOCHASTIC INFLOWS,' BY C. C. MAJI AND E. O. HEADY,
California Univ., Davis. Dept. of Civil Engineering.
S. Arora, and O. Helweg.
Water Resources Bulletin, Vol 17, No 3, p 508-509, June, 1981.

Descriptors: *Reservoir operation, *Planning, Linear programming, Model studies, Crop production.

The above titled paper, published in Water Resources Bulletin, Vol 16, No 3, p 438-443, 1980, uses linear programming to solve water resources problems. The authors of this comment point out several difficulties arising from the presentation: (1) the variable, A sub ijt, having the dimension of acres, is not properly defined and should be dimensionless, (2) the value of Indian currency must be given the proper value when the model is applied to future years by using an appropriate discount rate, (3) suggested water storage figures obtained from the model solution are less than the water demand, and (4) post-optimal analyses, comprising sensitivity analysis and parametric programming, of optimal solutions was omitted. (Cassar-FRC)
W84-00526

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE LAKE MICHIGAN BASIN, WISCONSIN,
Geological Survey, Madison, WI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-00546

A COMMENTARY ON COLUMBIA RIVER INSTREAM FLOWS,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
H. D. Copp.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-133651, Price codes: A03 in paper copy, A01 in microfiche. Water Research Center Completion Report, August 1983. 21 p, 8 Fig, 2 Tab, 10 Ref. OWRT A-113-WASH(1), 14-34-0001-2151.

Descriptors: *Columbia River, Fisheries, *Hydropower, Instream flow, *Water management, *Regulated flow.

The Washington State Department of Ecology in 1980 adopted the Columbia River Instream Resource Protection Plan (CRIRPP). This plan requires that flowrates in the river be at least at minimum specified levels (or higher) at all times. Columbia River flowrates are highly regulated by storage and hydropower plants. Plant discharge fluctuates accordingly to fairly-well established power demands, particularly in low water years. CRIRPP requires that streamflow regulation would need to be modified so that outflows from plants are higher than at present. In turn, this means that power demand patterns would have to be modified, significant spill would be necessary, or some of both. There appears to be sufficient

runoff, even in low runoff years, specifically, to meet CRIRPP requirements at Columbia River locations upstream from the Snake River confluence. The Pacific Northwest Power Planning Act (PL 96-501) likely will impact Columbia River water management even more dramatically than CRIRPP. An analysis of these impacts is beyond the scope of the study reported here; however, a brief discussion is included.
W84-00641

4B. Groundwater Management

LONG-TERM VARIATIONS OF GROUNDWATER RESOURCES OF THE NORTHERN HEMISPHERE,
For primary bibliographic entry see Field 2F.
W84-00380

RECHARGE FROM AN EPHEMERAL STREAM FOLLOWING WETTING FRONT ARRIVAL TO WATER TABLE,
Ministry of Agriculture and Water, Riyadh (Saudi Arabia).
For primary bibliographic entry see Field 2F.
W84-00390

LONG-TERM IMPACTS OF SURFACE MINING ON GROUND WATER IN TEXAS DELTA PLAIN LIGNITE MINES,
For primary bibliographic entry see Field 5B.
W84-00421

BURIED TREASURES OF THE HIGH PLAINS,
Camp, Dresser and McKee, Inc., Austin, TX.
J. O. Williams.
Water/Engineering and Management, Vol 130, No 3, p 26-27, March, 1983. 1 Tab.

Descriptors: *Groundwater management, *Water shortage, *Agriculture, Water conservation, Ogallala aquifer, Irrigation, Aquifers, Groundwater depletion, Water management, *High Plains Region, United States.

The Department of Commerce study on the Ogallala Aquifer predicted that groundwater depletion would reduce the total irrigated acreage by 5.1 million acres, or 1/3 of the total 1977 acreage, by 2020. The regional economy is not expected to suffer as much as was initially predicted because of water conservation practices and a shift to crops requiring less water (cotton and wheat). Water reserves are expected to drop (from 1977 to 2020) by 51% in Colorado, 25% in Kansas, 16% in Nebraska, 60% in New Mexico, 52% in Oklahoma, and 69% in Texas. (Cassar-FRC)
W84-00482

DEVELOPING AND MONITORING MUNICIPAL GROUNDWATER SUPPLIES IN FLORIDA,
West Coast Regional Water Supply Authority, Clearwater, FL.
For primary bibliographic entry see Field 6D.
W84-00573

GROUNDWATER USE MANAGEMENT IN THE NORTHEASTERN STATES--LEGAL AND INSTITUTIONAL ISSUES.
For primary bibliographic entry see Field 6E.
W84-00594

GROUND WATER RESOURCES OF THE GLACIAL-OUTWASH ALONG THE WHITE RIVER, JOHNSON AND MORGAN COUNTIES, INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
Z. C. Bailey, and T. E. Imbrigiotta.
USGS Water-Resources Investigations 82-4016, Nov. 1982. 87 p, 27 Fig, 10 Tab, 41 Ref.

Descriptors: *Aquifer characteristics, Geohydrologic boundaries, Geohydrology, Glacial drift, Ground-water movement, Groundwater potential, Groundwater recharge, *Hydrologic models, *Indiana, Iron, Losing streams, Manganese, Observation well, Organic carbon, *Outwash, Seasonal variation, Surface-groundwater relations, Unconfined aquifers, Water-quality standards, *Groundwater model, *Groundwater quality, Johnson County, Morgan County, Water quality assessment, White River.

An 88-square-mile segment of the White River valley contains an unconfined sand and gravel aquifer ranging-from a featheredge zero, to 120 feet in saturated thickness. Hydraulic conductivity is 340 feet per day, and transmissivity is as much as 35,000 square feet per day. The aquifer, recharged primarily by precipitation, gains same recharge through interbedded till and outwash boundaries and through losing streams. A two-dimensional digital model was used to simulate the steady-state ground-water flow system. Sensitivity analyses tested the reaction of the model to adjustments in hydraulic conductivity, steam bed leakance, and recharge. Simulated pumpage of 20-, 66-, and 122-million gallons per day reduced streamflow by 5, 15, and 30%, respectively. A real drawdown did not exceed 25 feet. Ground water was a calcium bicarbonate type having a median pH of 7.1, a mean alkalinity of 240 milligrams per liter, a mean hardness of 280 milligrams per liter, a mean dissolved oxygen concentration of 2.2 milligrams per liter, a mean redox potential of +347 millivolts, and a mean dissolved-solids concentration of 366 milligrams per liter. Iron and manganese concentrations exceeded National Drinking Water Regulations in 15 and 49% of the analyses, respectively. Temperature and concentration of dissolved organic carbon varied seasonally. Dissolved carbon and manganese varied with seasonally. Dissolved carbon and manganese varied with differing boundary material, till and bedrock. (USGS)
W84-00609

PRELIMINARY EVALUATION OF THE POTENTIAL FOR ARTIFICIAL GROUNDWATER RECHARGE IN EASTERN SAN JOAQUIN COUNTY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
H. T. Mitten.
USGS Open-File Report 82-123, July 1982. 31 p, 13 Fig, 2 Tab, 19 Ref.

Descriptors: *Artificial recharge, *Groundwater recharge, Recharge, *California, San Joaquin Valley, Central Valley, San Joaquin County.

In response to increasing demand on water supplies and declining water levels in San Joaquin County, the U. S. Geological Survey, in cooperation with the San Joaquin County Flood Control and Water Conservation District, is evaluating the potential for artificially recharging the aquifer system in eastern San Joaquin County, California. Through a well canvass and analyses of existing data on geology, soils, and drillers logs, this study (phase one of three phases) resulted in identification of 20 sites for exploratory test drilling in areas potentially favorable for artificial recharge. Ten of the sites are in areas adjacent to the Mokelumne River, six are in areas adjacent to the Calaveras River and Mormon Slough, and four are north of Littlejohns Creek. (USGS)
W84-00645

SIMULATIONS OF FLOW IN A GLACIAL OUTWASH AQUIFER, SOUTHERN FRANKLIN COUNTY, OHIO,
Geological Survey, Columbus, OH. Water Resources Div.
A. C. Razem.
USGS Water-Resources Investigations Report 83-4022, 1983. 32 p, 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Computer models, Aquifer characteristics, *Glacial aquifers, Pumping, Groundwater recharge, Surface-groundwater relations, *Drawdown, *Ohio, *Columbus, Middle Scioto River Valley.

A two-dimensional, finite-difference model is used to simulate transient flow conditions in a glacial outwash aquifer in southern Franklin County, Ohio. The model was calibrated by matching observed and simulated water-level changes for December 1977 through March 1980. Drawdowns for three different hypothetical pumping rates are simulated with the calibrated flow model. An increase in the pumping rate from the steady-state rate of 10 cubic feet per second to 48 cubic feet per second results in water-level declines of 10 to 20 feet near the area of the pumping wells. Declines of 20 to 40 feet result when the pumping rate is increased to 70 cubic feet per second, and a simulated pumping well goes dry when the combined pumping is increased to 94 cubic feet per second. For the first two cases, steady-flow conditions are reached after 12 years of pumping; infiltration through riverbeds accounts for 28 to 33% of the pumpage.
W84-00656

4C. Effects On Water Of Man's Non-Water Activities

EFFECTS OF UNDERGROUND MINING AND MINE COLLAPSE ON THE HYDROLOGY OF SELECTED BASINS IN WEST VIRGINIA,
West Virginia Geological and Economic Survey, Morgantown.
For primary bibliographic entry see Field 2F.
W84-00547

HYDROLOGIC DATA FOR URBAN STUDIES IN THE HOUSTON, TEXAS, METROPOLITAN AREA, 1979,
Geological Survey, Houston, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00602

HYDROLOGIC DATA FOR URBAN STUDIES IN THE DALLAS, TEXAS, METROPOLITAN AREA, 1979,
Geological Survey, Fort Worth, TX. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00603

EFFECTS OF SANITARY SEWERS ON GROUND-WATER LEVELS AND STREAMS, NASSAU AND SUFFOLK COUNTIES, NEW YORK--PART I: GEOHYDROLOGY, MODELING STRATEGY, AND REGIONAL EVALUATION,
Geological Survey, Syosset, NY. Water Resources Div.
T. E. Reilly, H. T. Buxton, O. L. Franke, and R. L. Wait.
USGS Water-Resources Investigations 82-4045, 1983. 45 p, 12 Fig, 6 Tab, 48 Ref.

Descriptors: *Groundwater, Model studies, Surface groundwater relationships, *Sewers, Simulation, *Computer models, Long Island, *New York.

A computer simulation of Long Island's regional groundwater system has been used to evaluate the effects that new-installed sewers will have on ground-water levels. Results indicate maximum water-table decliners of as much as up to 18 feet in central Nassau County and about 9 feet in Suffolk County. Total stream base flows and freshwater outflow to the south shore bay system will decrease by 22%. The regional scale of the model does not permit detailed predictions for individual streams. To quantify the effects of lowered ground-water levels on individual streams, two fine-scale sub-regional models have been designed. This report, the first in a three-part series describing the simulated effects of sewers in southern Nassau and southwestern Suffolk Counties, presents the hydrogeologic setting, pertinent literature, modeling strategy, subregional model design, and the results obtained to date from the regional ground-water model. The regional model results described will be used in the later reports to generate flux boundary conditions for the subregional models. (USGS)
W84-00679

4D. Watershed Protection

TO REMEDY EROSION: CONTOUR SPREADER-SEEPAGE FURROWS,
J. Hindson.
Environmental Conservation, Vol 9, No 3, p 251, 1982.

Descriptors: *Erosion control, *Storm runoff, Groundwater supplies, Groundwater development, Erosion, Contour spreader-seepage furrows, Contour terracing, Contours.

The use of contour spreader-seepage furrows to control the flow of storm water down a slope is described. A cut is made in the earthen slope, thus allowing a place for the storm water to collect. This cut is spread along the top of the slope, allowing the collected water to likewise spread out for 100-200 meters before being sent over the edge of the cut and on down the slope. The soil taken from the slope to make the cut is spread on top of the slope on the downhill side, where the water will eventually begin to trickle over the edge. The spreading effect on concentrated storm-water runoff is probably the largest single benefit of the contour spreader-seepage furrow program. The other major benefit is the water storage and infiltration aspect of the work. The groundwater (water table) will inevitably benefit very considerably, especially in deep absorbent soils. This means that erstwhile springs could begin to flow again and wells and water holes would not dry up. In areas needing improved groundwater supplies, CSFs may provide the answer so long as there is periodic surface storm water runoff which would otherwise run to waste. (Baker-FRC)
W84-00358

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

A SIMPLE FIELD TEST FOR THE DETECTION OF FAECAL POLLUTION IN DRINKING WATER,
Defence Research and Development Establishment, Gwalior (India). Div. of Microbiology.
K. S. Manja, M. S. Maurya, and K. M. Rao.
Bulletin of the World Health Organization, Vol 60, No 5, p 797-801, 1982. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Water analysis, *Water quality control, *Feces, Drinking water, Pollutant identification, Coliforms, Hydrogen sulfide, Human disease, Hepatitis.

A very simple method is presented for assessment of contamination in drinking water based on the detection of hydrogen sulfide-producing organisms. This new test was found to be reliable, simple to perform, and required few facilities. The concentrated medium used in the test contained 20 g of peptone, 1.5 g of dipotassium hydrogen phosphate, 0.75 g of ferris ammonium citrate, 1 g of sodium thiosulfate, 1 ml of Teepol, and 50 ml of water. Aliquots of 1 ml of the concentrated medium were absorbed onto folded tissue paper which was placed in a McCartney bottle, sterilized, and dried at 50C under sterile conditions. The water samples to be screened for faecal pollution were placed in the bottles, up to a pre-calibrated mark (20 ml) and allowed to stand at ambient temperature (30-37C). Fecal pollution is indicated if the contents of the bottle turn black within 12-18 hours, in which case the water was graded as unfit for consumption. This test should be useful for screening rural water supplies and for large-scale screening of urban water supplies where resources, time, manpower, and laboratory facilities are limited. (Baker-FRC)
W84-00364

LONG-TERM STUDY OF VIRUS CONTAMINATION OF SURFACE WATER IN THE GERMAN DEMOCRATIC REPUBLIC,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
R. Walter, H. -J. Dobberkau, W. Bartelt, W. Diener, and I. Hartel.
Bulletin of the World Health Organization, Vol 60, No 5, p 789-795, 1982. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Surface waters, *Viruses, *Public health, Germany, Berlin, Human disease, Pollutant identification, Water quality, Drinking water, Water treatment, Disinfection, Enteroviruses, Coxsackie virus.

From 1970 to 1979 a total of 1908 surface water samples from 30 sampling points were evaluated for determination of the concentration of viruses. The rate of virus isolation ranged from 8 to 92%, with a mean of 20%. There were considerable differences in isolation rate among the sampling points, and the rate for any particular point varied from year to year. The mean value of virus concentration was 2.7 cytopathogenic units per liter, while the maximum was 22.1 CU/liter. Viruses seen during the 10 year period included poliovirus types 1, 2, and 3, echovirus types 6, 11, and 30, and coxsackievirus B 3 and B 5; echovirus 7 and 24, coxsackievirus B 1, and adenovirus 5 were seen occasionally. The findings reflected the high level of use of surface waters in the German Democratic Republic. Where water is intended for human use such as drinking or recreation, reasonable safety measures such as water treatment and disinfection should be taken to ensure that the level of viral contamination is within the permissible limits. (Baker-FRC)
W84-00365

RADIUM-224 IN NATURAL WATERS MEASURED BY GAMMA-RAY SPECTROMETRY,
Chevron USA, Inc., New Orleans, LA.
R. J. Eisinger, P. T. King, and W. S. Moore.
Analytica Chimica Acta, Vol 144, p 277-281, 1982. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Pollutant identification, *Radon, *Isotopic tracers, *Spectrophotometry, Radioisotopes, Isotope studies, Estuaries, Separation techniques, Groundwater, Fate of pollutants.

A method based on germanium (lithium) gamma-ray spectrometry was applied to the determination of radon 224 in natural waters. The radon radioisotope is removed from several hundred liters of water by preconcentration onto manganese dioxide-impregnated acrylic fibers. The acrylic fibers are leached with water, and the radium is coprecipitated with barium sulfate. The gamma-ray activity is counted so that the activity ratios among the 224, 226, and 228 radon isotopes can be determined. Concentrations are calculated by using the radon 226 concentration determined on a small separate sample. The method was applied to the determination of radon in groundwater and estuarine and continental shelf waters. (Geiger-FRC)
W84-00372

PRESENCE OF ASBETOS FIBERS IN DRINKING WATER IN THE FEDERAL REPUBLIC OF GERMANY AND HEALTH EVALUATION OF THE RESULTS (UNTERSUCHUNGEN ZUM VORKOMMEN VON ASBESTFASERN IN TRINKWASSER IN DER BUNDESREPUBLIK DEUTSCHLAND UND GESUNDHEITLICHE BEWERTUNG DER ERGEBNISSE),
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
E. Meyer.
Gas- und Wasserfach: Wasser/Abwasser, Vol 123, No 2, p 85-96, February, 1982. 9 Fig, 5 Tab, 35 Ref.

Descriptors: *Asbestos, *Drinking water, Water pollution sources, Pipes, Chemical reactions, Analysis public health.

The results of a preliminary study on the presence of asbestos fibers in drinking water are presented. Measurements were performed by filtering water samples (generally 0.5 liter) through a 0.45 micron cellulose acetate membrane filter, ashing the filter and the residue, suspending the residue in water, and again filtering on a polypolycarbonate filter. The filters are applied to a carbon sample holder, and a silver layer is vapor-deposited onto the sample. The prepared samples are read in a scanning electron microscope with an electron beam microanalysis attachment. The possibilities for confusion of asbestos fibers with particles of other mineral fibers present in water are reduced with this method. The results of the study show that in some cases asbestos-like fibers of natural origin are contained in surface and ground waters. Analysis of water samples taken after the water has passed through asbestos pipes demonstrated that the release of asbestos fibers is determined by the chemical qualities of the water. When the water passing through the pipes is almost saturated with calcium carbonate, there is no release of asbestos fibers. An outline of the present state of the art with respect to the evaluation of the health effects of asbestos fibers ingested with drinking water is also presented. (Carroll-FRC)
W84-00374

DETERMINATION OF THE COMPONENTS OF WASTE WATER FORM BIS (2-ETHYLHEXYL) PEROXYDICARBONATE PRODUCTION BY GAS-SOLID CHROMATOGRAPHY (BESTIMMUNG DER ZUSAMMENSETZUNG DES ABWASSERS AUS DER BIS(2-ETHYLEHEXYL) PEROXYDICARBONATE-PRODUKTION MIT HILFE DER GAS-ADSORPTIONS-CHROMATOGRAPHIE),
Instytut Ciezkiej Syntezy Organicznej Blachownia, Kedzierzyn Kozle (Poland).
P. Kusz, E. Pisarzewska, A. Andrysiak, and Z. Kwasnicki.
Fresenius Zeitschrift fuer Analytische Chemie, Vol 313, No 1, p 44-45, 1982. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Water analysis, *Chromatography, *Industrial wastes, *Peroxydicarbonates, Polymerization, Pollutant identification.

Organic peroxydicarbonates are active initiators of radial polymerization of various compounds such as vinyl chloride, ethylene, vinylidene chloride and others. Usually these peroxydicarbonates are produced in a two-stage process, the first stage involving phosgenation of the related alcohol and the second stage being oxidation of the ester produced to give the dialkyl peroxydicarbonate. A method is presented for the determination of the composition of waste water arising from washing of the product after the second stage is completed. For the analysis a gas chromatograph equipped with a thermal conductivity detector is employed. The column temperature is programmed in a range of 60-250 degrees C with an increment of 12 degrees C per 1 min. The temperature of the injector and detector was 250 degrees C. Helium microliters were injected by means of a S.G.E. microsyringe of 5 microliter capacity. This procedure allowed separation of all components of wastewater from bis(2-ethylhexyl)peroxidicarbonate production. Oxygen, 2-ethylhexanol-1 and 2-ethylhexyl chloroformate as 2-ethylhexyl chloroformate as 2-ethylhexyl chloroformate oxidation products were determined in waste water using standards. In order to calculate each content n-propanol was used as internal standard. (Baker-FRC)
W84-00422

DIRECT AND SIMULTANEOUS STRIPPING VOLTAMMETRIC DETERMINATION OF ZINC, CADMIUM, LEAD, THALLIUM, AND COPPER IN ENVIRONMENTAL WATERS IN THE PRESENCE OF HUMIC ACIDS (INVERSVOLTAMMETRISCHE DIREKTE UND SIMULTANE BESTIMMUNG VON ZINK, CADMIUM, BLEI, THALLIUM UND KUPFER IN NATURLICHEN WASSERN IN GEGENWART VON HUMINSAUREN),
Muenster Univ. (Germany, F.R.). Anorganisch-Chemisches Inst.
F. Schlieckmann, and F. Umland.
Fresenius' Zeitschrift fuer Analytische Chemie, Vol 314, No 1, p 21-24, 1983. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Chemical analysis, *Heavy metals, *Humic acids, *Pollutant identification, Lead, Copper, Thallium, Zinc, Cadmium, Natural waters.

A new method is described which enables the direct and simultaneous determination of zinc, cadmium, lead, thallium, and copper in humic acid containing waters without separation from the organic material. The anodic-stripping voltammetric method (ASV) is used in a potassium hydroxide (KOH)/carbonate electrolyte. The supporting electrolyte is 0.1 N in KOH and 0.04 M in citrate and is adjusted with carbon dioxide gas to pH 10 to 10.5. Citrate suppresses the precipitation of carbonates, especially calcium carbonate. Zinc is recorded by direct current ASV. The current is then switched over to alternating current ASV for recording the other elements. A linear concentration dependence of all elements has been found down to 20 parts per billion in the presence of humic acid. (Author's abstract)
W84-00423

ACIDS AND BASES IN FRESH-WATERS, INTERPRETATION OF RESULTS FROM GRAN PLOTS,
Oslo Univ. (Norway). Inst. for Kjemi.
K. Molvaersmyr, and W. Lund.
Water Research, Vol 17, No 3, p 303-307, March, 1983. 4 Fig, 3 Tab, 7 Ref.

Descriptors: *Acids, *Bases, *Water analysis, *Pollutant identification, *Gran plots, Hydrogen ion concentration, Titration.

Problems with Gran plot analysis of strong and weak acids in natural water samples are discussed. Analysis of synthetic samples prepared from sodium bicarbonate and sodium acetate produced negative values for the strong acid, indicating that the HCl added prior to each titration was consumed by the bases. A corresponding positive value was obtained for weak acids, showing that the bases were not volatilized upon acidification. The pH range of titration is important for reliable results. Incorrect results were obtained for the titration range 4.1-9.6, although this range on the Gran plot had straight line regions at 4.1-4.3 and 9.4-9.6. Reliable results were obtained in the pH range 3.6-10.3, obtained by adding more HCl at the state of the titration. This range should cover both samples containing acids with low pKa values (requires low starting pH) and high pKa values (requires high end pH). (Cassar-FRC)
W84-00443

REPORT OF 1981 ORGANIC CHEMICAL SURVEILLANCE SURVEY AT COMMUNITY WATER SYSTEMS IN NEW YORK STATE,
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
J. Close, K. Slade, and K. Markussen.
August 1982. 9 p, 6 Append.

Descriptors: *Groundwater contamination, *Chemical wastes, *Contamination, *Organic compounds, *Toxins, *Groundwater pollution, Water supply, Water quality data, Water quality standards, *New York.

Community water systems, serving at least five water connections used by year-round residents or regularly serving at least 25 year-round residents, were surveyed by the Bureau of Public Water Supply Protection for organic chemical contamination. Samples representing a single source were collected from 58 systems and samples representing each of two sources were collected from 11 systems for a total of 80 samples from 69 community water systems. Organic chemicals were found in both ground and surface sources of supply. Trihalomethanes were detected in 29 of the 80 samples which represented 25 of the 69 community water systems sampled. Additional organic chemicals were detected in 28 of the 80 samples which represented 26 of the 69 community water systems sampled. Two water systems were found to have an unacceptable level of organic chemicals present; however, each system has discontinued using the contaminated source and has actively pursued permanent corrective action. Additional organic chemical surveys are recommended along with ongoing surveillance programs to detect these chemicals. (Garrison-Omniplan)
W84-00495

POTENTIAL HAZARDS OF NITRATE AND FLUORIDE IN UNDERGROUND WATER,
R.B.S. Coll., Bichpuri (India). Dept. of Agricultural Chemistry and Soil Science.
B. Pal.
Water Research, Vol 17, No 3, p 353-354, March, 1983. 2 Tab, 14 Ref.

Descriptors: *Nitrates, *Fluorides, *Water quality standards, Groundwater, Water analysis, Agra, *India, Saline water, Conductivity, Drinking water, Irrigation water, Pollutant identification.

A series of 113 groundwater samples collected from wells in the semiarid tract of Agra, India, contained up to 148.8 mg per liter nitrate and up to 18.5 mg per liter fluoride. Nitrate and fluoride levels increased with increasing conductivity from an average of 18.1 mg per liter nitrate and 0.6 mg per liter fluoride at 1-2 mmhos per cm to an average of 100.6 mg per liter nitrate and 10.1 mg per liter fluoride at >15 mmhos per cm. Fluoride levels exceeded 1 mg per liter (drinking water standard) in 49% of samples and exceeded 10 mg per liter (safe limit for crops) in 23.1% of samples. Nitrate levels exceeded the 10 mg per liter standard for drinking water in 86.6% of samples and exceeded 45 mg per liter (International Standards for Drinking Water) in 40% of samples. (Cassar-FRC)
W84-00528

IRRIGATION-WATER QUALITY IN THE SULPHUR CREEK BASIN, YAKIMA AND BENTON COUNTIES, WASHINGTON, APRIL 1976 THROUGH MARCH 1977,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7A.
W84-00541

SURFACE-WATER QUALITY DATA FROM SELECTED SITES IN WASHINGTON AFFECTED BY MOUNT ST. HELENS ERUPTIONS: MARCH 27 - SEPTEMBER 30, 1980,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00542

DETERMINATION OF TRIAZINES IN WATER BY GC AND LC,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Dept. of Analytical Chemistry.
M. Popl, Z. Voznakova, and V. Tatar.
Journal of Chromatographic Science, Vol 21, No 1, p 39-42, 1983. 5 Fig, 2 Tab, 13 Ref.

Descriptors: *Pollutant identification, *Herbicides, *Gas-liquid chromatography, *Triazine pesticides, *Sorption, Pesticides, Separation techniques, Chromatography, Gas chromatography, Water analysis.

A new method was formulated for the chromatographic determination of trace amounts of s-triazine-type herbicides in water. Model water samples were prepared by introducing a volume of the triazine standard in methanol, at concentrations ranging from 200 to 4000 ppm, into 50 milliliters of distilled water. After preconcentration by sorption on a macroporous polymer sorbent and desorption with acetone, s-triazines are determined in the desorbate by gas or liquid chromatography. The s-triazines in water may be detected at the 0.1 ppb level by use of gas-liquid chromatography with a nitrogen-phosphorus detector, or at the ppb level by liquid chromatography with an ultraviolet detector. Recovery from the preconcentration step is virtually complete and analysis takes no more than 1.5 hr. (Geiger-FRC)
W84-00567

STANDARD PLATE COUNT: A COMPARISON OF POUR PLATE AND SPREAD PLATE METHODS,
California Water Service Co., San Jose.
R. H. Taylor, M. J. Allen, and E. E. Geldreich.
Journal of the American Water Works Association, Vol 75, No 1, p 35-37, January, 1983. 1 Fig, 4 Tab, 20 Ref.

Descriptors: *Pollutant identification, *Heterotrophic bacteria, *Bacterial analysis, *Culturing techniques, Aquatic bacteria, Water analysis, Statistical methods, Bacteria.

Evidence from the literature is presented which shows that the standard pour plate procedure recovers only a very low percentage of the total bacterial population present in a water sample. In a long-term study involving routine sampling of dead-end water mains in the Cincinnati, Ohio distribution system, the spread plate and pour plate procedures of bacterial recovery were compared. Of the 613 samples collected, 571 yielded acceptable bacterial counts by both methods. Statistical analysis of test efficiency showed that the spread plate procedure was more precise and more accurate than the pour plate procedure for enumerating heterotrophic plate count population. The spread plate counts consistently decreased as chlorine levels increased, whereas pour plate results were not as consistent through the entire range of free chlorine residuals. While both the spread plate and pour plate procedures offer distinct advantages over the current standard method, analysts must continue to do comparative, parallel testing until they are included in a future edition of Standard Methods. (Geiger-FRC)
W84-00574

QUALITY-OF-WATER DATA AND STATISTICAL SUMMARY FOR SELECTED COAL-MINED STRIP PITS IN CRAWFORD AND CHEROKEE COUNTIES, SOUTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00650

TRACE ELEMENT ANALYSIS OF GROUNDWATER: COMPARISON OF PROTON-INDUCED X-RAY EMISSION (PIXE) WITH ATOMIC ABSORPTION ANALYSIS (AA),
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemistry.
G. S. Hall.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136795, Price codes: A03 in paper copy, A01 in microfiche. Center for Coastal and Environmental Studies Completion Report, July 1983. 22 p, 5 Fig, 3 Tab, 13 Ref. OWRT A-064-NJ(1), 14-34-0001-1132.

Descriptors: Heavy metals, *Groundwater pollution, Chelating agents, X-rays, *Trace elements, *Atomic absorption spectroscopy, *Proton-induced x-ray emission(PIXE).

A simple, rapid, sensitive, accurate, and multielemental analytical method was developed for trace element analysis of groundwater. The method incorporated preconcentration of the water sample with sodium dibenzyldithiocarbamate (NaDBDTC) and was followed by quantitative analysis using external beam proton-induced X-ray emission (PIXE). The emphasis was on quantitative analysis of the elements on the EPA priority pollutant list that included Sb, Cu, Se, Ag, Th, Ni, Zn, Pb, As, Cd, and Hg. The method is particularly attractive for PIXE analysis because akali, akaline, and halogen elements were not complexed. The detection limits for the method were in the 50-60 parts per trillion range using a 6 minute proton irradiation. PIXE was compared with atomic absorption in terms of cost, sensitivity, accuracy, speed of analysis, and precision. It was found that the PIXE method was superior in all cases except for accuracy, in which the method was accurate within 10%.
W84-00685

5B. Sources Of Pollution

DISSIPATION OF MASSIVE QUANTITIES OF 2,4-D AND 2,4,5-T N-BUTYL ESTERS IN FIELD MINI-LYSIMETERS,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
J. T. Majka, H. H. Cheng, and T. J. Muzik.

Journal of Environmental Quality, Vol 11, No 4, p 645-649, October-December, 1982. 4 Fig, 3 Tab, 13 Ref.

Descriptors: *Herbicides, *Waste disposal, *Chemical wastes, Degradation, Fate of pollutants, Industrial wastes, 2,4-D, 2,4,5-T, Revegetation, Infiltration.

The fate of large quantities of the herbicides 2,4-D and 2,4,5-T n-butyl esters on three soils was studied from December 1976 to April 1979 in minilysimeters located in Pullman, Washington. The esters were applied in a 1:1 mixture at the rates of 560 or 2800 kg per ha to simulate an accidental spill from damaged drums or from disposal of industrial wastes. Soils were: Washington silt loam with pH 5.5, Wyoming clay loam with pH 7.6, and Mississippi sandy loam with pH 4.7. At the lower application rate, both esters dissipated to <1% of the initial concentration in the surface layer by the end of the experiment in the Washington and Wyoming soils; little dissipation of either ester took place in the Mississippi soil. At the higher application rate in all soils 2,4-D concentrations in the soil surface layer decreased slightly, and 2,4,5-T concentrations changed negligibly. Some downward migration of the herbicides from the surface layer to the 5-10 cm deep layer was evident. At the end of the experiment revegetation was noticeable only on the Washington and Wyoming soils at the lower application rate. (Cassar-FRC)
W84-00355

LABORATORY STUDY OF SULFURIC ACID SPILL CHARACTERISTICS PERTAINING TO MARITIME ACCIDENTS,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
I. N. Tang, W. T. Wong, H. R. Munkelwitz, and M. F. Flessner.
Environmental Science and Technology, Vol 16, No 9, p 587-593, 1982. 8 Fig, 1 Tab, 15 Ref.

Descriptors: *Water pollution sources, *Acids, *Accidents, Ships, Marine environment, Sulfuric acid.

Several acid-spill scenarios are briefly described; they were designed to simulate the two most important types of accidental acid spills reported. In the first type the convective mixing of concentrated sulfuric acid with water is shown to be governed by the buoyancy force arising from changes in acid concentration and released heat of dilution. In the second type, experiments with oleums have resulted in the formation of dense clouds of acid aerosols well within the respirable particle size range. The first type can be adequately described by a mathematical model, taking into account the variation of the buoyancy force arising from changes in acid concentration and liberated heat of dilution. A value of 0.21 is determined to be the entrainment parameter for the sulfuric acid-water system. For the second type a conservative estimate of less than 0.1% is obtained to represent the amount of airborne acid under most accident conditions. The fraction of airborne acid, however, decreases very rapidly with increasing release depth below the water surface. The acid aerosols exhibit a well-defined lognormal particle size distribution, with peak diameter varying from 0.1 to 0.6 micrometers depending upon release depths. Caution should be exercised when extrapolating these data to larger spills. (Baker-FRC)
W84-00359

SALMONELLA SPECIES AND SEROTYPES ISOLATED FROM FARM ANIMALS, ANIMAL FEED, SEWAGE, AND SLUDGE IN SAUDI ARABIA,
American Univ., Beirut (Lebanon). Dept. of Microbiology.
N. H. Nabbut, E. K. Barbour, and H. M. Al-Nakhli.
Bulletin of the World Health Organization, Vol 60, No 5, p 803-807, 1982. 2 Tab, 12 Ref.

Descriptors: *Salmonella, *Sludge, *Sewage bacteria, Land disposal, Saudi Arabia, Manure, Bacteria, Human disease, Public health, Epidemiology, Animal diseases.

The isolations of salmonellae from farm animals, animal feed, sewage, and sludge in Saudi Arabia during 1977-1980 are reported. A total of 264 salmonellae representing 65 different species and serotypes were isolated for the first time in that country. The six most frequently isolated Salmonella species or serotypes were: livingstone, concord, 'S. schottmuelleri' (invalid), lille, S. typhimurium, and cerro. Of 61 samples of sewage, 37 were positive for Salmonella; 22 of 47 sludge samples were positive. The isolation of 30 different Salmonella species and serotypes from sewage and 11 from sludge indicates that sewage and sludge play a role in the dissemination of salmonellae in the environment and possibly to man and animals. This dissemination would be more significant if inadequately treated sewage effluents and sludges were used for the irrigation of crops or as soil conditioners. Sewage may be an important indirect source of salmonella infection in animals. Cases of salmonellosis in cattle may result from the application of sewage and cattle slurry to land, but it is difficult to tell how easily cattle grazing on contaminated pastures might become infected. (Baker-FRC)
W84-00363

RELEASE OF METHYL MERCURY FROM SEDIMENTS: EFFECTS OF MERCURY CONCENTRATION, LOW TEMPERATURE, AND NUTRIENT ADDITION,
Manitoba Univ., Winnipeg. Dept. of Microbiology
D. R. Wright, and R. D. Hamilton.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 39, No 11, p 1459-1466, 1982. 9 Fig, 38 Ref.

Descriptors: *Methylmercury, *Mercury, *Sediments, Lake sediments, River sediments, Microorganisms, Nutrients, Temperature effects, Biomethylation.

Methyl mercury release from unpolluted, mercury polluted, and mercury enriched lake and river sediments was studied using a flow-through system in plexiglass 'microbasins'. The release of methyl mercury as a function of time from Clay Lake and Wabigoon River mercury-laden sediments characteristically demonstrated a lag during the first week, an increase to a maximum at about 4 weeks followed by a decrease to a steady lower level related to mercury concentration. Production of methyl mercury ranged up to 3.3 micrograms/sq m/day increasing with increasing mercury content as if following saturation kinetics. It leveled off when mercury content was 15-20 micrograms Hg/g. An equilibrium between methylating and demethylating mechanisms is suggested. Release at 4C was 50-70% of that at 20 degrees, suggesting that in polluted Canadian lakes production in winter may be half the total for the year. Increased methyl mercury release was noted when tryptic soy broth was added to sediments at 0.06 to 0.25 g/cubic dm, and very marked increases when added to the water flow at 35 mg/l, suggesting an effect at the sediment-water interface. (Baker-FRC)
W84-00366

LEACHING CHARACTERISTICS OF LIGNITE ASH,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
M. J. Humenick, M. Lang, and K. F. Jackson.
Journal of the Water Pollution Control Federation, Vol 55, No 3:1, p 310-316, March, 1983. 2 Fig, 4 Tab, 14 Ref.

Descriptors: *Groundwater pollution, *Coal gasification, *Leaching, *Ash, Trace metals, Groundwater, Texas, Water pollution control, Sulfates, Calcium, Temperature effects, Aluminum, Arsenic, Boron, Phosphorus, Selenium, Silicon, Zinc.

Contaminants generated by water influx into burn cavities resulting from in situ coal gasification and the subsequent leaching of materials from residual ash are considered. The scope of work included a laboratory study of solubility effects, ash temperature, water temperature, lignite composition, and ash mineralogy. Lignite samples were obtained from three Texas sites. Ash content of the samples varied by more than a factor of three, whereas the mineral composition of ash varied with combustion temperature and source of lignite. The major ions released to groundwater during leaching were calcium and sulfate. Hydroxide seemed to be released in lesser quantities than when leaching ash from western coals. Leaching at 20C indicated calcium and sulfate release to be proportional to the amount of these constituents in the ash, whereas leaching at 80C exhibited no effect of ash composition on calcium and sulfate release. Release of material at 80C was less than that at 20, indicating that additional material can be released to groundwater over time as the surroundings cool. The release of sparingly soluble material is reasonably predicted by ionic equilibrium models. Of the 34 trace elements tested for in leachate samples, only aluminum, arsenic, boron, phosphorus, selenium, silicon, and zinc were found in concentrations having some significance. Restoration of groundwater contaminated because of ash leaching can be achieved by withdrawal of cavity water. (Baker-FRC)
W84-00383

OXYGEN DEMAND OF TACONITE TAILINGS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
R. H. Plumb, and G. F. Lee.
Journal of the Water Pollution Control Federation, Vol 55, No 3, p 317-322, March, 1983. 3 Fig, 5 Tab, 18 Ref.

Descriptors: *Oxygen demand, *Mine wastes, *Lake sediments, Oxygen, Water pollution effects, Taconite, Sediments, Lake Superior, Dissolved oxygen.

The possible oxygen demand of tailings deposited from a mining company into Lake Superior was investigated. The disposal site was selected because of the deep, about 274 m, offshore trench that could accommodate the tailings discharge without a significant decrease in depth. The discharge was found to exert a small, but definite demand on the oxygen of the lake sediments. Oxidation of ferrous iron appeared to be the mechanism responsible for the observed demand. A model was used to estimate the oxygen concentration changes in Lake Superior based on laboratory results. The oxygen losses were estimated to be 0.3 mg/l at the surface of the tailings deposit, which would decrease exponentially to 0 mg/l at 5 m above the deposit. One field study indicated dissolved oxygen concentration depletions of 0.1 to 0.2 mg/l above the tailings deposit. Other survey results suggest that natural variation is greater than predicted oxygen concentration changes from the discharge of taconite tailings. Taconite tailings have been discharged continuously since 1955, and DO concentrations in the bottom waters of Lake Superior still exceed 12 mg/l. It can therefore be concluded that the discharge of taconite tailings is not having a significant impact on the dissolved oxygen concentrations in the lake. (Baker-FRC)
W84-00384

EXPERIMENTAL INVESTIGATION ON IRREVERSIBLE CHANGES OF HYDRAULIC CONDUCTIVITY ON THE SEAWATER-FRESHWATER INTERFACE IN COASTAL AQUIFERS,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2F.
W84-00403

MECHANISMS LEADING TO ENRICHMENT OF THE ATMOSPHERIC FLUOROCARBONS CCL3F AND CCL2F2 IN GROUNDWATER,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
A. D. Russell, and G. M. Thompson.
Water Resources Research, Vol 19, No 1, p 57-60, February, 1983. 4 Fig, 3 Tab, 15 Ref.

Descriptors: *Fluorocarbons, *Groundwater dating, *Sorption, Fate of pollutants, Air pollution, Dating, Adsorption, Soil gases, Soil moisture, Water pollution sources, Industrial wastes.

The fluorocarbons CCl3F and CCl2F2 were determined in distilled water extracts of dry soil samples from 8 sites in Arizona. Soil samples were assumed to contain fluorocarbons in equilibrium with the atmosphere. Mean levels of CCl3F (ng per liter) in the supernatant water were 1.13-6.69; increases over the control, 0.62, were 83-981%. Mean levels of CCl2F2 (ng per liter) in the supernatant water were 0.51-1.29; increases over the control, 0.53, were from -3.7 to 144%. Correlation between the percentage increase in fluorocarbons in the water to clay and organic matter content was very good for CCl3F and good for CCl2F2. The probable reason for the increase of fluorocarbons in water is desorption from soil surfaces due to competition with water molecules for sorption sites. If soil air in contact with recharge water is also in contact with the atmosphere through cracks and open pore spaces, it may degas, reducing the concentration of fluorocarbons in water reaching the aquifer. Conversely, infiltrating water with little contact with the atmosphere would become enriched as it dissolved fluorocarbons from soil air with increased partial pressures of these chemicals. These findings may explain some anomalies in groundwater dating studies using the fluorocarbon method. (Cassar-FRC)
W84-00406

THREE-DIMENSIONAL STOCHASTIC ANALYSIS OF MACRODISPERSION IN AQUIFERS,
New Mexico Inst. of Mining and Technology, Socorro.
L. W. Gelhar, and C. L. Axness.
Water Resources Research, Vol 19, No 1, p 161-180, February, 1983. 10 Fig, 3 Tab, 43 Ref.

Descriptors: *Anisotropy, *Stochastic hydrology, *Solute transport, Porous media, Aquifer properties, Mixing, Hydraulic conductivity, Convection, Model studies, Groundwater movement.

The dispersive mixing resulting from complex flow in three-dimensional heterogeneous porous media is analyzed using stochastic continuum theory. Stochastic solutions of the perturbed steady flow and solute transport equations are used to construct the macroscopic dispersive flux and evaluate the resulting macrodispersivity tensor in terms of a three-dimensional, statistically anisotropic input covariance describing the hydraulic conductivity. With a statistically isotropic input covariance, the longitudinal macrodispersivity is convectively controlled, but the transverse macrodispersivity is proportional to the local dispersivity and is several orders of magnitude smaller than the longitudinal term. With an arbitrarily oriented anisotropic conductivity covariance, all components of the macrodispersivity tensor are convectively controlled, and the ratio of transverse to longitudinal dispersivity is of the order of 0.1. In this case the off-diagonal components of the dispersivity tensor are significant, being numerically larger than the diagonal transverse terms, and the transverse dispersion process can be highly anisotropic. Dispersivities predicted by the stochastic theory are shown to be consistent with controlled field experiments and Monte Carlo simulations. The theory, which treats the asymptotic condition of large displacement, indicates that a classical gradient transport (Fickian) relationship is valid for large-scale displacements. (Author's abstract)
W84-00408

COPPER (II) BINDING BY HUMIC ACID EXTRACTED FROM SEWAGE SLUDGE: AN ELECTRON SPIN RESONANCE STUDY,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
S. A. Boyd, Le. E. Sommers, D. W. Nelson, and D. X. West.
Soil Science Society of America Journal, Vol 47, No 1, p 43-46, 1983. 1 Fig, 2 Tab, 28 Ref.

Descriptors: *Copper, *Humic acid, *Sludge, Electron spin resonance, Soil organic matter, Organic matter, Chelation, Chemical reactions, Protein, Fate of pollutants.

Binding of Cu(++) by humic acid extracted from sewage sludge was studied with electron spin resonance spectroscopy. Spectral data of the Cu-humic acid complex and some adducts with nitrogen donors (pyridine, 1,10-phenanthroline, and ethylenediamine) showed that Cu(++) formed two equatorial bonds with humic acid oxygen donor ligands. The data were consistent with the formation of a copper chelate in the original Cu-humic acid complex. The ligand field strength of the humic acid oxygen donor ligands coordinated to Cu(++) was stronger than that of water. Cu(++) also appeared to form axial bonds with humic acid donor ligands originating from proteinaceous materials associated with the sludge humic acid. Characterization of an adduct with glycylglycine showed that the dipeptide formed coordinate bonds with Cu(++) bound to humic acid. (Cassar-FRC)
W84-00417

LONG-TERM IMPACTS OF SURFACE MINING ON GROUND WATER IN TEXAS DELTA PLAIN LIGNITE MINES,
C. R. Pollock.
Bulletin of the Association of Engineering Geologists, Vol 20, No 1, p 1-4, 1983. 2 Fig, 7 Ref.

Descriptors: *Groundwater pollution, *Lignite, *Mining, Texas, Groundwater resources, Water supply development, Aquifers, Water quality, Mine wastes.

Long-term hydrogeologic impacts of surface mining were investigated in 25-year-old mined land at an active delta plain lignite mine in Texas. Four monitoring wells were installed near a runoff collecting lake that occupies part of the initial box cut of the original mine. A groundwater system has developed in this old surface mined land. The water table in the resaturated spoil is at the same depth as in the pre-mine overburden, not more than 6 to 8 m below the surface. Mapping of the potentiometric surface in the mine spoil reveals that ground water in the immediate vicinity of the lake discharges to the lake. However, groundwater distant from the lake generally flows to the southsoutheast in the direction of regional groundwater before mining. By studying the water chemistry of resaturated mine spoil at this active delta plain lignite mine it was determined that long-term adverse impacts of surface mining on groundwater hydrology are minimal. Resaturated mine spoil is a water table aquifer that is capable of transmitting as much water as the pre-mine overburden; mine spoil will generally resaturate within 20 years after mining. Interruptions of groundwater flow in surface mined land should be of limited duration. Spoil water quality is similar to but more mineralized than that of the pre-mine overburden water. Surface mining should not seriously degrade groundwater quality beyond the mine boundaries. (Baker-FRC)
W84-00421

THE COMPOSITION AND DEPOSITION OF ORGANIC CARBON IN PRECIPITATION,
New York State Coll. of Agriculture and Life Sciences, Ithaca.
For primary bibliographic entry see Field 2K.
W84-00424

TRACE METALS IN A TROPICAL RIVER ENVIRONMENT - SPECIATION AND BIOLOGICAL TRANSFER,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
A. C. Paul, and K. C. Pillai.
Water, Air, and Soil Pollution, Vol 19, No 1, p 75-86, 1983. 1 Fig, 16 Tab, 13 Ref.

Descriptors: *Trace metals, *Speciation, *Rivers, *Sediments, Fish, Rice, Copper, Zinc, Cadmium, Manganese, Industrial outfall, Industrial wastes, Public health.

The transfer and uptake of trace metals such as copper, manganese, zinc, cadmium, nickel, and iron in the river environment were considered. Surface water samples were collected daily from two locations, 100 m apart, at the industrial outfall area in the river. Sediments were sampled from different locations in the river. Samples of milk were analyzed from cows grazing on the contaminated pasture at the industrial zone. Samples of fish were taken from the river. Trace metals were present in varying ratios in the dissolved and suspended fractions in river water. Trace metals, particularly cadmium and zinc showed higher concentration in sediments at the industrial zone, attributed to the industrial pollutions. All metals showed a wide range of concentration in the humic fraction of the sediments. Trace metals were higher in milk from cows fed on contaminated pasture when compared to the control cows. Analyses of fish in the river from different zones indicate varying levels of concentration in tissue. Zinc was generally concentrated in the bone as was manganese. Cadmium showed highest levels in the liver. The total intake of trace metals by a person living in the industrial zone would be calculated on the basis of the average concentration in each food item. Based on the assumption that the person consumes only the items that are produced locally it is estimated that the intake of zinc exceeds that of the reference man by about 3600 micrograms/day. The major intake, nearly 90%, is through rice grown on irrigated fields. The intake of cadmium also exceeds that of reference man, while copper and iron consumption fall short. (Baker-FRC)
W84-00426

THE MOVEMENT OF METALS APPLIED TO SOILS IN SEWAGE EFFLUENT,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
K. W. Brown, J. C. Thomas, and J. F. Slowey.
Water, Air, and Soil Pollution, Vol 19, No 1, p 43-54, 1983. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Heavy metals, *Land disposal, *Sewage disposal, Erosion, Permeability, Leaching, Scil types, Water pollution sources, Land management.

The fate of five heavy metals when applied to four diverse soils in secondary treated sewage effluent was examined. Spiking of the samples was done to simulate long term metal additions from effluents low in total metals. The sewage effluent had a mean BOD of 6.4 mg/1, a mean total organic carbon of 34.4 mg/1 and a pH of 7.8. It was spiked with sulfates of Cd, Cu, Ni, and Zn and the nitrate of Pb to concentrations which averaged 0.82, 0.83, 0.75, 0.91, and 0.74 mg/1 of each metal, respectively. The soils used were Bastrop, a udic paleustalf; Lakeland, a typic quartzipsamment; Nacogdoches, a rhodic paleudalf; and Norwood, a typic udifluvent. Subsamples of the leachate water were collected monthly from all lysimeters throughout the study to determine if any of the metals moved from the soil profiles. Results indicated that while the metals did move in the soil, none entered the leachate collected 150 cm below the surface during this study. Thus even highly permeable soils such as the Lakeland were able to retain the metals applied in sewage effluent and decrease the potential for movement in the groundwater. Since the metals did accumulate in the surface soil, good land management techniques will be needed to minimize the movement of metals via soil erosion. (Baker-FRC)
W84-00429

25 YEARS OF FISSION PRODUCT INPUT TO LAKES SUPERIOR AND HURON,
Ministry of State for Science and Technology, Ottawa (Ontario).
B. L. Tracy, and F. A. Prantl.
Water, Air, and Soil Pollution, Vol 19, No 1, p 15-27, 1983. 4 Fig, 5 Tab, 27 Ref.

Descriptors: *Radioactive wastes, *Water pollution effects, *Lakes, Great Lakes, Lake Huron, Lake Superior, Fish, Fallout, Bioaccumulation, Strontium, Cesium, Antimony, Sedimentation, Lake sediments, Sediment-water interfaces.

At the present time, virtually all fission products in the upper Great Lakes are the result of fallout from nuclear weapons testing. The concentrations of the fission products Sr-90, Sb-125, Cs-137, and Ce-144 in the water, sediments and biota of Lakes Superior and Huron were examined. No significan

differences were noted between concentrations from open water and coastal water in Lake Huron, suggesting that releases from the nuclear generating station at Douglas Point did not have a significant influence on fission product concentration. Sr-90 and Sb-125 appear to be removed from lake water primarily by radioactive decay, whereas rapid settling plays a large role for Cs-137. However, from 3 to 30% of this fission product persists in the water for many years after its introduction. Once deposited in the sediments of the upper Great Lakes, fission products remain at or near the sediment-water interface. This could facilitate their re-entry into the water and could provide an explanation of the persistence of Cs-137 in lake water. Great lakes fish contained concentrations of Cs-137 several thousand times higher than in ambient water. A health evaluation of the effects of consuming water and fish from the upper lakes over the past 25 years shows no basis for concern. The 50-yr committed dose equivalents are well within national and international limits. It is cautioned that a large scale release of fission products from a nuclear facility could lead to elevated concentrations in water and fish, and consequently to an increased radiological burden to surrounding populations for many years to come. (Baker-FRC)
W84-00430

AN ASSESSMENT OF ACID RAIN ON LEACHING OF ELEMENTS FROM DELAWARE SOILS INTO GROUNDWATER,
Delaware Univ., Newark. Coll. of Agricultural Sciences.
D. L. Sparks, and C. R. Curtis.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120849, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Completion Report (1983). 111 p, 5 Fig, 2 Tab, 12 Ref. OWRT A-053-DEL(1), 14-34-0001-2108.

Descriptors: *Acid rain, *Leaching, *Groundwater pollution, *Ion transport, Soil properties, Cation exchange, Anion exchange, Leachates, Heavy metals, Delaware.

The effects of acid rain on the kinetics of elemental release from three major Delaware soil types were investigated. All three soils contained low clay and organic matter contents which would indicate rather low buffering capacities. The kinetics of elemental release were evaluated by leaching the soils with simulated acid rain at pH levels of 2.5, 3.4, 4.8, and 5.6. Leachates were collected until an apparent equilibrium in elemental release was obtained. In all soils and at all acid rain pH levels, quantities of basic elemental release were in the order Ca K Mg Na. The amount of heavy metals and Si release were very low. As the pH of the acid rain decreased, the total quantity of each released element increased. In all cases, a rapid initial release of each element was followed by slower release rates. The kinetics of Al release were characterized by a similar time trend. The greatest Al release rates occurred at pH 2.5 from the soil type with the lowest clay and organic matter contents and thus the poorest buffering capacity. The Al that was released at pH 2.5 from the soils would probably be either monomeric or polymeric Al; however, some release could have occurred from the clay structures. Anionic release, including Ca super -, SO sub 4 super =, and NO sub 3 super -, was evaluated and found to be negligible.
W84-00434

ORGANIC CHEMICALS AND DRINKING WATER,
New York State Dept. of Health, Albany.
N. K. Kim, and D. W. Stone.
Report April 1981. 70 p, 8 Fig, 27 Tab, 22 Ref. 12 Append.

Descriptors: *Organic compounds, *Contamination, *Drinking water, *Chemical wastes, *Groundwater pollution, *Water pollution, Herbicides, Hazardous materials, Toxins, Wells.

In 1977 the New York State Department of Environmental Conservation (DEC) conducted an Industrial Chemical Survey to determine types and amounts of organic chemicals used, stored or manufactured by industries in the state. Data indicate that large quantities exist throughout the state. DEC's spill summary for 1978 shows that many accidental discharges of hazardous material and toxic chemicals occur each year. This has been documented by studies of Long Island's groundwater and upstate New York's supply wells. Some examples of the types of toxic or hazardous material spilled are sodium cyanide, acetone, chromic acid, heavy metal sludge, hydrocarbon waste, paint, pesticides, dry cleaning solvents and PCB's. Pesticides and herbicides identified in the State and Federal drinking water regulations (endrin, lindane, methoxychlor, toxaphene, 2,4-D and 2,4,5-TP Silvex) were generally not found in surface source community water systems. The data show that contamination is widespread and not restricted to a particular area of the state. In Nassau and Suffolk County wells, the most common contaminant was tetrachloroethylene. (Garrison-Omniplan)
W84-00497

SURVIVAL AND DISTRIBUTION OF AEROMONAS HYDROPHILA IN NEAR-SHORE COASTAL WATERS OF PUERTO RICO RECEIVING RUN DISTILLERY EFFLUENT,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
E. J. Biamon, and T. C. Hazen.
Water Research, Vol 17, No 3, p 319-326, March, 1983. 8 Fig, 5 Tab, 29 Ref.

Descriptors: *Bacteria, *Organic matter, *Wastewater disposal, Survival, Fate of pollutants, *Aeromonas hydrophila, Coliforms, San Juan, *Puerto Rico, Fermentation, Plumes, Pathogens.

Aeromonas hydrophila densities and water quality parameters were determined at a control station and at 5 stations in the plume of a large rum distillery discharge near San Juan, Puerto Rico. Densities of A. hydrophila varied from 10 CFU per ml at the unpolluted site to 1 million CFU per ml at the point of discharge. Densities of A. hydrophila were significantly higher in the plume than at the control site and decreased with distance from the discharge point. The density of the pathogen showed significant correlation with temperature, total phosphorus, total organic carbon, and orthophosphate. Suspensions of A. hydrophila placed in diffusion chambers at the discharge source survived and increased in density. Those placed in the unpolluted site rapidly decreased in density with time. Densities of fecal coliforms and standard count bacteria within the plume were 0.3 to 50 CFU per ml and about 1 million to 100 million CFU per ml, respectively, and were not correlated with distance from the source. (Cassar-FRC)
W84-00519

INVESTIGATIONS ON BOTTOM SEDIMENTS OF HUNGARIAN RIVERS AND RESERVOIRS. DETERMINATION OF MINERALOGICAL COMPOSITIONS BY INSTRUMENTAL ANALYTICAL METHODS,
Veszpremi Vegyipari Egyetem (Hungary). Inst. for Analytical Chemistry.
J. Hlavay, J. Kristof, J. Borszeki, F. Laszlo, and P. Literathy.
Water Research, Vol 17, No 3, p 327-332, March, 1983. 5 Fig, 7 Tab, 11 Ref.

Descriptors: *Mineralogy, *Sediments, *Adsorption, Fate of pollutants, Sajo River, Tiszar River, Kiskore Reservoir, *Hungary, Bottom sediments, Clays, Surface area, Reservoirs, Rivers.

Bottom sediments from 10 sites in the Sajo River, Tisza River, and Kiskore Reservoir, Hungary, highly polluted with industrial wastes, were analyzed to determine the mineralogical composition, organic matter content, degree of crystallinity, silicon dioxide content, quartz content, and specific surface area. These investigations, using infrared spectroscopy, thermoanalytical methods, classical analytical methods, X-ray powder diffraction, and vapor absorption measurements, showed that properties of sediments from all the sites and the connected reservoir differed only slightly. This indicates that the sediments studied have similar capacities to adsorb heavy metals and to settle out at similar rates. Specific surface areas were 8 to 22 sq m per g, with the higher values obtained for reservoir samples. (Cassar-FRC)
W84-00527

THE EFFECT OF SEDIMENT ON THE BIODEGRADATION OF 2,4,6-TRICHLOROPHENOL IN DELAWARE RIVER WATER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Environmental Science.
L. A. Blades-Fillmore, W. H. Clement, and S. D. Faust.
Journal of Environmental Science and Health, Part A, Vol 17, No 6, p 797-818, 1982. 11 Fig, 1 Tab, 26 Ref.

Descriptors: *Phenols, *Degradation, *Sediments, Fate of pollutants, *Trichlorophenol, Suspended sediments, Biodegradation, Microbial degradation, Organic compounds, *Delaware River.

Water and bottom sediment from 11 sites in the Delaware River from Mile 146 (Washington's Crossing) to Mile 63 (New Castle) were used in studies of 2,4,6-trichlorophenol (TCP) biodegredation (initial concentration, 50 micrograms per liter). Incubation of sterilized control systems showed no degradation during the 22 days of study and very little adsorption onto sediments. The sampling site had no correlation with degradation rate in either water or water/sediment systems. Water systems showed a lag period several days before TCP degradation began; water/sediment systems did not. Averaged half-lives were: sediment/water, unstirred, 7.6 days; water alone, 12.8 days. Using different substrates half-lives were: glass beads, 5 days; sterile gravel, 10 days; sterile sand, 13 days. The relationship between suspended sediment and rate of degradation was indicated by the following half-lives: 7 days for a 1 g per liter suspension. A positive relationship was shown for the rate of biodegradation and exposed surface area. This study showed that surfaces for bacterial attachment play an important role in microbial degradation. (Cassar-FRC)
W84-00577

DEGRADATION OF SELECTED PHENYLUREA HERBICIDES BY ANAEROBIC POND SEDIMENT,
Clemson Univ., SC. Dept. of Microbiology.
H. H. Attaway, III, M. J. B. Paynter, and N. D. Camper.
Journal of Environmental Science and Health, Part B, Vol 17, No 6, p 683-699, 1982. 6 Tab, 17 Ref.

Descriptors: *Herbicides, Degradation, Sediments, *Monuron, *Diuron, *Fenuron, *Microbial degradation, Anaerobic conditions, Ponds, Fate of pollutants, Urea pesticides, *Anaerobic digestion.

Anaerobic degradation of the herbicides diuron, monuron and fenuron in pond sediments was investigated. Sediment from a diuron-treated pond dehalogenated diuron to 3-(3-chlorophenyl)-1,1-dimethylurea in 17-25 days. Sterile sediment, sediments from non-diuron-treated ponds, or inert surfaces of clay, sand, or cellulose did not degrade diuron. Degradation occurred at 25 and 30C but not at 37C or at 15C or below. Degradation was most rapid at 30C. Diuron-treated sediment stored under refrigeration for 8 months retained its ability to degrade diuron. Monuron, 3-(4-chlorophenyl)-1,1-dimethylurea, and fenuron, 1,1-dimethyl-3-phenylurea, were not degraded by pond sediments. The fact that the para-chlorine of monuron was not removed implies that the enzyme(s) responsible for reductive dehalogenation requires electronegativity of the meta-chlorine, as in diuron. (Cassar-FRC)
W84-00578

SURVIVAL OF ENTERIC VIRUSES AND INDICATOR BACTERIA IN GROUNDWATER,
Texas Univ. Medical School at Houston.
B. H. Keswick, C. P. Gerba, S. L. Secor, and I. Cech.
Journal of Environmental Science and Health, Part A, Vol 17, No 6, p 903-912, 1982. 2 Tab, 13 Ref.

Descriptors: *Bacteria, *Viruses, *Groundwater, Fate of pollutants, Enteric bacteria, Enteroviruses, Indicators, Survival, Public health.

Bacteria and viruses survived in flowing groundwater for the 24-day duration of a laboratory experiment using organisms on Nucleopore polycarbonate membranes in McFeter's survival chambers. Water flow was continuous at 0.5 to 5 liters per min and 3 to 15C. Decay rates (as log (concentration after 24 hours/initial concentration)) in units per day were: Coliphage f2, -0.39; Rotavirus SA-11, -0.36; Escherichia coli, -0.32; Fecal streptococcus, -0.23; Poliovirus 1, -0.21; and Coxsackievirus B3, -0.19. (Cassar-FRC)
W84-00579

AN EVALUATION OF THREE PESTICIDE RUNOFF LOADING MODELS,
Environmental Research Lab., Athens, GA.
M. N. Lorber, and L. A. Mulkey.
Journal of Environmental Quality, Vol 11, No 3, p 519-529, 1982. 2 Fig, 17 Tab, 22 Ref.

Descriptors: *Pesticides, *Nonpoint pollution sources, *Sediment transport, Atrazine, Toxaphene, Insecticides, Model studies, Runoff, Fate of pollutants, Agricultural watersheds, Erosion, Sediment yield, Cotton, Agricultural runoff management model, Continuous pesticide simulation, Chemical runoff and erosion from Agricultural management Systems.

Three nonpoint source runoff models were compared for their ability to predict the movement of pesticides (toxaphene and atrazine) from watersheds. The models were Agricultural Runoff Management (ARM), Continuous Pesticide simulation (CPS), and Chemical, Runoff, and Erosion from Agricultural Management Systems (CREAMS). Total toxaphene losses (g per ha for a 12-month period) from a cotton plantation on a 15.6 ha Mississippi Delta watershed were: ARM, 105.98; CPS, 96.67; CREAMS, 105.85, and observed, 96.53. Erosion (tons per ha) for the same site and period were: ARM, 25.73; CPS, 27.93; CREAMS, 19.63; and observed, 26.25. Runoff predictions were within 15% of observed values. Prediction of peak events varied widely among the models, with CREAMS values for runoff, soil loss, and toxaphene loss generally less than half those of the ARM model, and CPS values less than 40% of ARM values. Predicted atrazine losses from a small Southern Piedmont watershed were very similar for all three models. (Cassar-FRC)
W84-00584

HEAVY ELEMENT RELEASE TO GROUNDWATER AT IN-SITU URANIUM MINING SITES: PHASE I,
Wyoming Univ., Laramie. Dept. of Civil Engineering.
M. J. Humenick, W. L. Dam, and J. I. Drever.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132505, Price codes: A05 in paper copy, A01 in microfiche. Water Research Center Completion Report, August 1983. 75 p, 16 Fig, 5 Tab, 55 Ref, 5 Append. OWRT A-037-WYO(1), 14-34-0001-2154.

Descriptors: *Mine wastes, Groundwater pollution, Molybdenum, Vanadium, Arsenic, Selenium, Uranium, Leaching, Mass transfer, Wyoming, *Sandstone ores, *Heavy metals, Texas.

This laboratory experimental research project evaluated the mechanism and kinetics of release of heavy elements to groundwater from sandstone ores which have been mined by an in-situ leach process and subsequently subjected to groundwater flow through the mined area. Ore's from Wyoming and Texas were examined during the work, and heavy elements of interest were uranium, molybdenum, vanadium, arsenic, and selenium. The mechanism of release was found to be controlled by diffusion. The kinetics of release were modeled by an overall mass transfer relationship. Under conditions of the experiments, the heavy elements were calculated to be anionic in nature. Data were obtained and processed to provide required information to simulate field conditions when evaluating heavy element migration at uranium solution mining sites.
W84-00637

TIME OF TRAVEL OF THE FLINT RIVER, UTAH DAM TO HIGHWAY M-13, MICHIGAN: AUGUST 4-8, 1981,
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 2E.
W84-00647

VERTICAL MOVEMENT OF GROUND WATER UNDER THE MERRILL FIELD LANDFILL, ANCHORAGE, ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
G. L. Nelson.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $3.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-1016, 1982. 34 p, 8 Fig, 1 Tab, 5 Ref.

Descriptors: *Groundwater, *Hydraulics, Deep percolation, Sanitary fills, Vertical permeability, Aquifer testing, *Alaska, Anchorage.

Shallow groundwater under the Merrill Field sanitary landfill at Anchorage is polluted by leachate. Wells, including three Municipal-supply wells, obtain water from two confined aquifers 100-300 feet beneath the landfill area. Aquifer-test data and information on subsurface geology, ground-water levels, and properties of materials were used to estimate vertical gradients and vertical permeabilities under the landfill. The authors 'best estimates' of vertical permeabilities of two confining units are 1 x 10 super -2 foot per day and 2 x 10 super -4 foot per day. Theoretical travel-time calculations indicate that minor amounts of pollutants may reach the upper confined aquifer after many tens of years, but that water of the composition of the leachate probably would not reach the aquifer for more than three centuries. The range of error in the theoretical travel-time calculations is likely to be plus or minus a factor of two or three. (USGS)
W84-00648

ASBESTOS IN WATER SUPPLIES OF THE NORTHERN NEW JERSEY AREA: SOURCE, CONCENTRATION, MINERALOGY, AND SIZE DISTRIBUTION,
Rutgers - The State Univ., Newark, NJ. Dept. of Geology.
J. H. Puffer, G. P. Maresca, and M. Germine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136811, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute. Center for Coastal and Environmental Studies Completion Report, Rutgers Univ., New Brunswick, N.J., August 1983. 87 p, 22 Fig, 10 Tab, 122 Ref, 4 Append. OWRT A-067-NJ(1), 14-34-0001-2132.

Descriptors: *Asbestos, *Water supply, Bedrock, Drinking water, *Groundwater, Minerals, Quarries, Reservoirs, Rivers, Pollution, X-ray, Electron Microscopy, Rutile, Titanium oxide, Chrysotile, Crocidolite, Tremolite-Actinolite, *New Jersey, Staten Island, New York.

On the basis of the distribution of asbestos in the northern New Jersey area, four principal target areas were investigated for contamination of water supplies by bedrock asbestos: Staten Island, N.Y., Mendham, N.J., Franklin, N.J., and Easton, Pa. In the Silver Lake Reservoir in Staten Island, N.Y., where chrysotile from serpertinite bedrock exposures is a potential source of contamination, chrysotile asbestos levels of 15 to 86 million fibers per liter (MFL) were measured, with an average of 53 MFL. In Mendham, N.J., ground and surface water sources of municipal drinking water range in crocidolite fiber content from 0 to 4.7 MFL and probably originates from a major crocidolite-bearing fault zone that runs through the town. Franklin, N.J. was investigated to determine whether quarry runoff was contaminating a downstream water supply. Significant amounts (1.1 to 2.0 MFL) of tremolite-actinolite asbestos were found in a stream receiving quarry runoff. Asbestos levels of 0.3 to 3.45 MFL were found in the municipal supply, and probably result from a combination of natural bedrock erosion, ambient environmental contamination, and quarry runoff. Tremolite-asbestos from faulted marble was suspected as a contaminant of College Hill Reservoir, in Easton, Pa. However, asbestos levels at this location were not significantly above background.
W84-00683

5C. Effects Of Pollution

CHANGE IN QUALITY OF A SINGLE RIVER'S WATER ON ITS PASSAGE THROUGH TWO RESERVOIRS, LAKE BOIVIN AND GRANBY RESERVOIR (TRANSFORMATION DE LA QUALITE D'UNE MEME EAU DE RIVIERE LORS DE SON SEJOUR DAN DEUX RESERVOIRS DIFFERENTS: (A) LE LAC BOIVIN ET (B) LA RESERVE DE GRANBY, QUEBEC, CANADA),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
P. G. C. Campbell, D. Cluis, and P. Couture.
Canadian Water Resources Journal, Vol 7, No 1, p 127-150, 1982. 3 Fig, 7 Tab, 23 Ref.

Descriptors: *Reservoirs, *Water quality, Nitrogen, Phosphorus, Algal growth, Chlorophyll A, Nutrients, Quebec.

Nitrogen and phosphorus dynamics were studied during a 20-month period in two adjacent reservoirs used by the city of Granby, Quebec, Canada, for domestic and industrial water supplies. The two impoundments have a common water supply, the North Yamaska River, but differ considerably in their physical and biological characteristics. The river water entering the two reservoirs was highly enriched in phosphorus, reflecting land use practices in the upstream watershed. Concentrations of dissolved phosphorus at the inlet greatly exceeded the generally accepted water quality standards for standing waters. During summer stagnation, a lagged relationship was observed between indigenous phytoplankton chlorophyll-a and algal growth potential. Fluxes through each reservoir for a variety of parameters, including chlorine, conductivity, inorganic nitrogen, total phosphorus, algal growth potential, and chlorophyll-a, were calculated from data on concentrations and discharge measured at the inlet and outlet of each impoundment. Mass balance analysis showed that the two reservoirs were similar with respect to chlorine, inorganic nitrogen, phosphorus, and chlorophyll-a, but differed significantly with respect to the algal growth potential. The input-output budgets for algal growth potential were balanced in the main-stream reservoir, but were strongly negative in the off-channel reservoir. The implications of the study results for the modeling of water quality in other reservoirs are briefly discussed. (Carroll-FRC)
W84-00370

THE EFFECT OF THERMAL EFFLUENT, BEFORE AND AFTER MACROPHYTE HARVESTING, ON STANDING CROP AND SPECIES COMPOSITION OF BENTHIC MACROINVERTEBRATE COMMUNITIES IN LAKE WABAMUN, ALBERTA,
Calgary Univ. (Alberta). Dept. of Biology.
J. B. Rasmussen.
Canadian Journal of Zoology, Vol 60, No 12, p 3196-3205, 1982. 6 Fig, 4 Tab, 49 Ref.

Descriptors: *Thermal pollution, *Temperature effects, *Benthic environment, Alberta, Lakes, Lake Wabamun, Canada, Heated water, Macroinvertebrates, Oligochaetes.

Prior to macrophyte harvesting the heated area of Lake Wabamun had higher submerged macrophyte production, greater amounts of plant detritus in the sediment, and a higher standing crop of benthic macroinvertebrates than the unheated area. In the heated area the warmest spots supported a community dominated by tubificid oligochaetes, and the moderately heated areas supported com-

munities dominated by large Chironomus, mainly of smaller chironomid species. The heated area was subjected to mechanical macrophyte harvesting, which removed the majority of the submerged macrophytes. This reduced the amount of plant detritus within the sediment and also the standing crop of benthic macroinvertebrates in the heated area. Species composition of the oligochaete-dominated community was not affected by harvesting. Species composition of the Chironomus-dominated area was greatly affected by harvesting and became more similar to that of the unheated area, with densities of the large Chironomous species being reduced to low levels, while the densities of smaller chironomid species increased. These findings suggest that the effects of thermal effluent on benthic animal communities in Lake Wabamun are partly a consequence of increased macrophyte production and the accumulation of detritus. However, the details of this interaction are obscure. (Baker-FRC)
W84-00376

OXYGEN DEMAND OF TACONITE TAILINGS,
Texas Tech Univ., Lubbock. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W84-00384

TRACE METALS IN A TROPICAL RIVER ENVIRONMENT-DISTRIBUTION,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
A. C. Paul, and K. C. Pillai.
Water, Air, and Soil Pollution, Vol 19, No 1, p 63-73, 1983. 1 Fig, 14 Tab, 14 Ref.

Descriptors: *Trace metals, *Rivers, *Distribution, Zinc, Cadmium, Industrial wastes, Monsoons, Periyar River, Sediments, Water pollution effects, India.

The distribution of trace metals in the Periyar River in Kerala and its backwaters was studied from 1976 to 1980. The river from Kalady to Moolampalli, a distance of about 50 km, has been divided into 3 zones: background, industrial, and backwater. In view of the overwhelming impact of monsoon runoff in the river flows a seasonal separation of the studies between monsoon and non-monsoon periods has been made. Background concentrations of trace metals increased in the river water during the summer partly due to increased solubilization and partly due to concentration through evaporation. The sediments also reflect the corresponding seasonal changes in the concentrations. There is preferential concentration of the finer particles that remain suspended. Meandering of the stream during monsoon, which results in reduction of flow velocity, is responsible for large scale deposition of suspended solids at the industrial zone. Industrial effluent discharge enhances the concentration of Zn and Cd, both in the water and in the sediments, in the industrial zone. The concentration of Mn and Cd in the water approaches the recommended safe limits for drinking water. Deleterious effects on smaller organisms are reported and possible synergistic effects are cited as the river is the recipient of a wide variety of chemical pollutants. There is also evidence for solubilization of trace metals in the backwater zone under the influence of higher salinity in summer. Solubilization may be regarded as a significant property by which the trace metals get transported to the marine regime. (Baker-FRC)
W84-00427

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
For primary bibliographic entry see Field 7B.
W84-00431

NITROGEN CYCLING AND PHOTOPLANKTON GROWTH IN THE NEUSE RIVER, NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Inst. for Coastal and Marine Resources.
D. W. Stanley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120906, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 204, North Carolina State Univ., Raleigh, August 1983. 92 p, 7 Fig, 7 Tab, 38 Ref. OWRT A-126-NC(1), 14-34-0001-2135.

Descriptors: *Eutrophication, *Nitrogen compounds, *Nitrogen cycle, *Phytoplankton, *Algal growth, *Rivers, *Estuaries, Nutrients, Nitrogen, Ammonia, Ammonification, Nitrates, Chlorophyll A, Algae, Bacillariophyceae, Chlorophyta, Dinoflagellates, Bacteria, River flow, Municipal wastewater, Wastewater disposal, North Carolina.

As part of an effort to understand the relationships between nutrient dynamics and nuisance algal blooms, this study addresses the transfers (among the air, water, sediments, and microorganisms) and transformations (from one form of the nutrient to another) of nitrogen nutrients as they travel through the Neuse River. Two sampling sites were chosen, but there was not as much difference in N kinetics between the upriver and downriver stations as had been anticipated. This probably stemmed from the fact that river flows were relatively high during the study, and the downriver area experienced riverine conditions (high dissolved inorganic nitrogen, low algal productivity), rather than the estuarine conditions (low DIN, high algal productivity) typical of other years. Phytoplankton biomass in the river was closely correlated (inversely) with river discharge rate. About 80% of the DIN assimilate by algae and bacteria in the river was NH sub 4-N, even though NO sub 3-N concentrations were usually 5-10 fold higher than NH sub 4-N. Significant NOsub 4-N utilization can be expected to occur only if the NH sub 4-N becomes depleted. During this study, NH sub 4-N did not become depleted because ammonification rates usually were high enough to provide enough DIN to supply the assimilation needs. Given the rapid recycling of NH sub 4-N and the large reservoirs of NO sub 3-N in the Neuse, DIN inputs will need to be reduced greatly before N limitation can act to control algal production.
W84-00440

EVALUATION OF ACID RAIN SENSITIVITY OF PENNSYLVANIA SOILS,
Pennsylvania State Univ., University Park. Coll. of Agriculture.
E. J. Ciolkosz, and E. R. Levine.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120922. Price codes: A06 in paper copy, A01 in microfiche. Institute for Research on Land and Water Resources Completion Report, The Pennsylvania State University, University Park, September 1983. 106 p, 7 Fig, 8 Tab, 157 Ref. OWRT A-058-PA(1), 14-34-0001-2140.

Descriptors: *Acid rain, *Soils, *Acid deposition, *Soil buffer capacity, *Soil acidification, *Computer simulation model, Cation exchange, Sulfate adsorption, Base saturation, Acidity, Mineral degradation, Aluminum hydrolysis, pH, Aluminum toxicity, Cation leaching, Soil sensitivity, Simulation, Prediction equations, Atmospheric sulfur, Atmospheric nitrogen.

Pennsylvania shares with its neighboring states the most acidic deposition that falls in the United States. The effect of acidity in the deposition on soils has not been fully evaluated. A computer simulation model was developed to determine the impact of various inputs of acid deposition on Pennsylvania soils. The model simulates the changes that occur in the solid phase of soils in humid, temperate climates that are undergoing acidification and cation leaching. To obtain predicitons about soil properties which closely matched actual field conditions, the state was divided into 10 regions based on physiography, county borders, and proximity to 1 of the 10 precipitation monitoring stations established by the Pennsylvania Department of Environmental Resources. Information from The Pennsylvania State University Soils Data Base for the major soil associations within each of these 10 regions, and the accompanying precipitation data, were used as input to the model. Simulations creating the 'worst case scenario' were designed using data for uncultivated and unlimed soils, and without a forest canopy or litter layers. Soils were classified into sensitivity classes based on the amount of time required for the soil to reach a threshold value of pH less than or equal to 4.0, aluminum concentration in the soil solution of 1.0 mg/l in the upper horizon,or aluminum concentration in the soil solution of 0.1 mg/l in the lower horizon. Very sensitive soils reached a threshold value within 30 years, sensitive soils attained this value within 60 years, slightly sensitive soils reached it within 90 years; non-sensitive soils did not attain critical levels within 90 years. Using the model, simulation results showed the Pennsylvania soils were either very sensitive or non-sensitive. Soils at the threshold values at the beginning of the simulation were very sensitive, while those not at the critical levels from the start of the simulation were classified as non-sensitive. Thus, the non-sensitive soils contain sufficient buffer capacity to withstand acid deposition inputs at present rates for at least 90 years. Correlation analysis of these results indicates that base saturation, exchangeable cations, exchangeably acidity, and pH are most closely associated with the sensitivity of Pennsylvania soils to acid deposition. Cation exchange capacity and sulfate adsorption showed very little association with soil sensitivity class predicted by the model.
W84-00442

THE EFFECTS OF POWER STATION COOLING WATER DISCHARGES ON AQUATIC ECOLOGY,
Central Electricity Generating Board, Leatherhead (England). Biology Dept.
G. D. Howells.
Water Pollution Control, Vol 82, No 1, p 10-17, 1983. 7 Fig, 2 Tab, 32 Ref.

Descriptors: *Cooling water, *Aquatic life, *Thermal pollution, Heated water, Water pollution effects, Reviews, Powerplants, Ecology, Fish, Temperature effects, Insects, Chlorine, Oligochaetes, Crustaceans, Invertebrates, *United Kingdom.

The properties and effects of cooling water dischargers from powerplants in the United Kingdom were reviewed. In this country the natural temperatures of rivers used for cooling water are 0 to 22C. Heated water discharges raise the temperatures to 8-10C above ambient. Stratification and low flow can produce considerably higher temperatures for brief periods. Lethal temperature limits for fresh water fish are usually above 32C. Previous exposure and adaptation are important factors. Data on preferred temperatures for fish are conflicting. Chlorine residuals above 0.5 mg per liter are regarded as lethal to marine and fresh water fish; lower concentrations can disturb younger animals or sensitive species (such as Crustacea) or some biological functions. During passage of cooling water through the tower, dissolved oxygen is greatly increased, carbon dioxide is decreased, and nitrification takes place. Downstream from heated water discharges oligochaetes are more numerous than at control sites. Crustacea appear to complete their life cycles more rapidly in warmer water. Effects on insect emergence patterns were difficult to ascertain because of the wide natural variability in emergence patterns. Fish in rivers receiving cooling water discharges tend to move toward the warm water in winter and away in summer. Discrepancies between laboratory and field studies showed the need for further work. (Cassar-FRC)
W84-00480

EVALUATION OF HIGH AND PROLONGED LEVELS OF SEWAGE WASTEWATER ON MARSH VEGETATION,
Delaware Univ., Newark. Coll. of Marine Studies.
F. C. Daiber, M. A. Hardisky, and P. L. Wolf.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-128610, Price codes: A04 in paper copy, A01 in microfiche. Completion Report, September 1983. 70 p, 15 Fig, 9 Tab, 47 Ref. OWRT A-054-DEL(1).

Descriptors: *Cycling nutrients, Nitrogen, Nitrates, Ammonium, Tidal marshes, Salt marshes, *Wetlands, Nutrient removal, Plant growth, Wastewater, Sewage, Sanitary wastewater, Wastewater outfall, Wastewater disposal, Water analysis, Chemical analysis, Saline water, Vegetation, Nutrients, Limiting nutrients, Delaware, Kent County, Murderkill River Marshes.

A Spartina cynosuroides marsh bordering a tidal gut receiving sewage effluent was compared with a similar marsh on a tidal gut receiving no sewage effluent. S. cynosuroides annual net aerial primary productivity ranged from 313-746 gdw m-2 yr-1 and was similar for the effluent and control marshes. If all plant species are included in the primary production calculation, the marsh on the effluent creek averaged 1050 gdw m-2 yr-1 and the marsh on the control creek averaged 800 gdw m-2 yr-1. The decomposition of S. cynosuroides leaves and stems from litter bags suggested that decomposition in the effluent marsh was significantly faster than in the control marsh. Analysis of plant tissue indicated plants in the effluent marsh had a significantly higher nitrogen concentration than plants from the control marsh early in the growing season. Near the end of the growing season, plants from the effluent marsh had lower or similar nitrogen concentrations to the plants from the control marsh. Despite very high concentrations of ammonia in the tidal water flooding the effluent marsh, luxury uptake of nitrogen by S. cynosuroides apparently did not occur. Lower soil salinities resulting from the large input of sewage effluent also contributed to the observed differences between the control and effluent marshes.
W84-00494

THE EFFECTS OF UNBALANCED AMMONIA AND BOD CONCENTRATIONS ON OXIDATION PONDS,
Ben-Gurion Univ. of the Negev, Sde Boker (Israel). Lab. for Environmental Applied Microbiology.
A. Abeliovich.
Water Research, Vol 17, No 3, p 299-301, March 1983. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Ammonia, *Photosynthesis, *Oxidation ponds, Wastewater treatment, Anaerobic conditions, Water quality, Oxygen, Toxicity, Water pollution effects, Biological oxygen demand, Wastewater lagoons, Lagoons, Ponds, Reservoirs.

High ammonia concentrations in an oxidation pond produced poor water quality in the receiving reservoir in spite of low effluent BOD levels. Although the pond effluent BOD was much lower in 1981 than in 1980, the reservoir BOD was nearly the same, about 45 mg per liter, in both years; the ammonia concentrations in the reservoir were 25 and 37 mg per liter in 1980 and 1981, respectively. Ammonia levels were inversely correlated with photosynthesis rates and with BOD levels in the reservoir. As a result of the low rate of photosynthesis, oxygen levels in the reservoir were low. To maintain a satisfactory water quality in the effluent and reservoir, the oxidation pond systems must be operated so that the ammonia and BOD levels both decrease simultaneously. (Cassar-FRC)
W84-00521

BIOLOGICAL CONSIDERATIONS IN THE SETTING OF QUALITY STANDARDS FOR THE TIDAL THAMES,
M. J. Andrews, J. E. C. Steel, and A. G. Cockburn.
Water Pollution Control, Vol 82, No 1, p 52-60, 1983. 1 Fig, 4 Tab, 46 Ref.

Descriptors: *Water quality standards, *Species composition, *Aquatic populations, Water pollution effects, Standards, Estuaries, Thames River, *United Kingdom, Fish, Invertebrates, Marine animals, Dissolved oxygen, Oxygen.

Biological standards for water quality in the Thames Estuary were established, using 5 categories (A to E, good to anoxic respectively), each defined by the composition of the populations of migratory fish, estuarine fish, and estuarine macroinvertebrates. These were correlated with dissolved oxygen values. During periods of recovery from pollution the rate of recovery is most rapid in fish, followed by mobile invertebrates, and then sedentary invertebrates. For example, a C quality water (poor) with a C estuarine invertebrate community may contain a B fish population, indicating improving water quality, or a D fish population, indicating worsening conditions. The third quarter minimum dissolved oxygen level of the Thames increased from 5.5% in 1968 to 44.2% in 1979. This was reflected by changes in the aquatic community: establishment of the prawn Palaemon longirostris in 1976, invasion of marine invertebrate species, and the increasing presence of smelt and rainbow trout, formerly sighted only on rare occasions. (Cassar-FRC)
W84-00523

POTENTIAL HAZARDS OF NITRATE AND FLUORIDE IN UNDERGROUND WATER,
R.B.S. Coll., Bichpuri (India). Dept. of Agricultural Chemistry and Soil Science.
For primary bibliographic entry see Field 5A.
W84-00528

SIGNIFICANCE OF EUTROPHICATION IN WATER SUPPLY RESERVOIRS,
W. W. Walker, Jr.
Journal of the American Water Works Association, Vol 75, No 1, p 38-42, January, 1983. 4 Fig, 35 Ref.

Descriptors: *Eutrophication, *Storage reservoirs, *Phosphorus, *Water quality control, *Watershed management, *Phosphorus removal, *Literature reviews, Model studies, Reviews, Organic loading, Organic carbon, Water pollution effects, Water supply, Limiting nutrients, Costs.

Some key relationships between eutrophication of surface water supplies and the costs and quality of finished water are reviewed. In view of current concerns over organohalides, problems with organics are most significant. Data from lakes and reservoirs in the United States show a positive correlation between total phosphorus and total organic carbon measurements. This correlation is indicative of the role of phosphorus as the limiting nutrient in the growth of aquatic plants and algae. The control of phosphorus export in watersheds is a potentially significant and cost-effective means of dealing with organics-related problems. Regionally-calibrated empirical models may be used with reservoir and watershed monitoring data to assess the extent, significance and controllability of phosphorus-related water quality problems. Water shed assessments also provide a means of arriving at local solutions to organics-related problems and of formulating land-use policies to protect water quality. (Geiger-FRC)
W84-00571

THE SENSITIVITY OF CEDAR SWAMPS TO THE EFFECTS OF NON-POINT SOURCE POLLUTION ASSOCIATED WITH SUBURBANIZATION IN THE NEW JERSEY PINE BARRENS,
Rutgers - The State Univ., New Brunswick, NJ. Center for Coastal and Environmental Studies.
J. G. Ehrenfeld, and J. P. Schneider.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136779, Price codes: A03 in paper copy, A01 in microfiche. Completion Report, September 1983. 42 p, 31 Fig, 32 Tab, 39 Ref, 8 Append. OWRT A-065-NJ(1), 14-34-0001-2132.

Descriptors: *Nutrients, *Non point pollution sources, *Swamps, Wetlands, *Urbanization, *Water pollution effects, Water level fluctuations, Plant communities, Plant growth, Urban watersheds, Heavy metals, Cedar bogs, Cedar trees.

Nineteen swamps dominated by Chamaecyparis thyoides were chosen to represent the following gradient of increasingly severe impacts due to watershed development: (1) isolated sites, far from roads; (2) isolated sites, near roads; (3) suburban sites with indirect runoff; and (4) suburban sites receiving storm sewer input. In both types of suburban sites, 'typical' Pine Barrens species were lost and many weeds and exotics invaded. Herb, shrub and fern densities did not change significantly along the gradient. The sites receiving storm sewer input showed an increased uptake of phosphorus and lead, but no significant changes for N, Cu or Zn; sites with indirect runoff showed no changes in tissue element concentrations. Sphagnum cover and cedar seedling density decreased sharply with disturbance. Cedar growth rate was found to be a complex function of tree age and site type; there was some evidence of increased increment growth with age in both kinds of suburban sites. In summary, the presence of direct stormwater input to cedar swamps causes marked changes in community structure, vegetation dynamics, and plant tissue element concentration. Developed watersheds, or even roads proximate to swamps, also cause changes, though less drastic, from conditions in swamps in undisturbed areas.
W84-00682

IMPACT OF CHANGING ACIDITY ON THE TROPHIC DYNAMICS OF PINE BARRENS PLANKTON COMMUNITIES,
Rutgers - The State Univ., Camden, NJ. Dept. of Biology.
M. D. Morgan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136803, Price codes: A03 in paper copy, A01 in microfiche. U.S. Dept. of the Interior, OWP. Center for Coastal and Environmental Studies Completion Report, Rutgers Univ., New Brunswick, N.J., September 1983. 38 p, 17 Fig, 3 Tab, 27 Ref. OWRT A-066-NJ(1), 14-34-0001-2132.

Descriptors: *Zooplankton, *Acid deposition, Nutrients, Bosmina coregoni, Lakes, Primary productivity, Hydrogen-ion concentration, *New Jersey, *Pine Barrens, Ponds, Oswego Lake, Nescochague Lake.

The physical, chemical, and biological limnology of Oswego Lake (an undisturbed New Jersey Pine Barrens pond), and Nescochague Lake (a pond disturbed by extensive agricultural and residential development) was investigated from June 1981 - May 1983. The impact of disturbance was most evident in pH and nutrients. On all occasions, the pH of Nescochague Lake (mean, based on H super + concentration = 5.3, range 4.5-7.8) exceeded the pH of Oswego Lake (mean - 4.2, range 3.9-4.6). Concentrations of NO sub 3 -N and total P were about 50 times greater in Nescochague Lake than in Oswego Lake (NO sub 3 -N range from 200-800 and 1-25 ug/L, respectively, and total P ranged from 240-600 and 2-16 ug/L, respectively). The biological response to these differences was most evident among the phytoplankton, which exhibited both greater biomass and productivity. Surprisingly, in view of the major differences in pH, the zooplankton communities of these ponds, except for differences in density, were quite similar. Over the two years studied, 35 species were collected from Oswego Lake and 29 from Nescochague Lake. Only 6 species were unique to Oswego Lake and none were unique to Nescochague Lake. In addition, both ponds were dominated by the same species (Bosmina coregoni in the spring and summer, and Eucyclops agilis and Chydorus brevilabris in the fall and winter). Field and laboratory experiments demonstrated that much of the increased pH of Nescochague Lake was a temporary result of high rates of photosynthesis, so that in the winter and at night, the pH approached levels characteristic of Oswego Lake. These periodic reductions in pH apparently restricted the zooplankton to a primarily acid tolerant assemblage, thus, explaining the overall similarity between the communities in Oswego and Nescochague Lakes. Alteration of Nescochague Lake pH in experimental enclosures confirmed this conclusion.
W84-00684

5D. Waste Treatment Processes

WASTEWATER TREATMENT BY SOILS: ROLE OF PARTICLE SIZE DISTRIBUTION,

Indian Inst. of Tech., Kanpur. Dept. of Civil Engineering.
V. Tare, and S. D. Bokil.
Journal of Environmental Quality, Vol 11, No 4, p 596-602, October-December, 1982. 9 Fig, 5 Tab, 18 Ref.

Descriptors: *Wastewater disposal, *Particle size, *Land application, Wastewater treatment, Soil properties, Sand, Silt, Land disposal, Ammonia, Nitrogen removal, Phosphates, Coliforms, Bacteria, Chemical oxygen demand.

Wastewater was treated by percolation through 7.5 cm diameter soil columns containing 100% sand, 100% silt, and mixtures in the proportions 80:20, 60:40, 40:60, and 20:80. Particle size distribution of the soil was a significant factor in effective wastewater treatment. A 60:40 sand:silt mixture was most suitable, combining the faster percolation rates of the sand with the better pollutant assimilation of the silt. A formula was developed for COD removal in soil as a function of depth. For the optimum soil system used in this study the depth below which no significant COD removal occurred was 45 cm. The overall COD reduction rate increased for about 16 days after initiation of wastewater flooding, then decreased, indicating that wastewater application should not be continuous but alternated with dry periods. Although phosphate removal was complete at <15 cm depth in soils containing part silt, 1-2 mg per liter phosphate was found in effluents at the 30 cm depth in sand. Removal of ammonia and total N was dependent on soil particle size, soil sorptive capacity and cation exchange capacity. Coliform concentrations were reduced by 1 order of magnitude in the sand and to zero in the optimum soil system. (Cassar-FRC)
W84-00352

IMPROVEMENT OF WATER USE EFFICIENCY IN IRONWORKS (RATIONALISIERUNG DER WASSERVERWENDUNG IN BETRIEBEN VON EISENHUTTENKOMBINATEN),
Forschungsinstitut fuer Wasserwirtschaft, Prague (Czechoslovakia).
P. Dockal.
Wasserwirtschaft-Wassertechnik, Vol 32, No 8, p 275-276, 1982. 4 Tab, 7 Ref. (No English Summary).

Descriptors: *Industrial water, *Refinery wastes, *Water cooling, *Wastewater treatment, *Pollution, Industrial wastewater, Cooling, Canals, Technology, Temperature, Oil, Suspended solids.

Iron and steel industries are among the largest consumers of water, requiring large quantities for various uses. In the last 10 years, new methods of recycling industrial waters have been developed. Experience has shown that increasing demands for steel quality result in greater wastewater pollution. New wastewater reuse methods are illustrated, based on a mixed-type plant including the Neue Hutte Ostrava. Water economy is visualized in terms of open and closed loops. Well planned recycling has minimized pollution under normal conditions, but breakdowns and work schedule changes can interfere with these plans. Principal efforts in the next few years should probably be directed toward dissipation of waste heat, minimizing the effects of operational interruptions, and improving wastewater treatment in the individual processes. (Titus-FRC)
W84-00356

SKOOKUMCHUCK DECOLORIZATION MEETS HIGH EXPECTATIONS.
Pulp and Paper Journal, Vol 35, No 5, p 12, 14, 1982. 2 Fig.

Descriptors: *Wastewater treatment, *Color, *Settling ponds, *Infiltration, Organic compounds, Canada, Industrial wastes, Kootenay River.

The $2.5 million rapid infiltration decolorization system installed in the fall of 1981 for a forestry operation in Canada effectively eliminated 90% of the effluent color which was formerly contaminating the nearby Kootenay River. The process begins with the effluent percolating through the soil, so that the dissolved organic solids were precipitated by soluble ions characteristic of the soil in the Kootenay River valley. These larger size insoluble molecules are then filtered by the soil. During the rest period, decomposition of some of the organic components left in the soil generates carbon dioxide which locally acidifies soil particles, thus releasing more soluble ions for the next dosing cycle. The treatment system also includes a polishing step, where the effluent remains in a 2.5 day basin to remove solids biologically generated in the aeration pond. It is after this polishing step that the rapid infiltration system comes into play. To evaluate effectiveness of the system at Skookumchuck, a total of 31 monitoring wells were drilled for a cumulative depth of about 2,800 feet. These wells have been installed to monitor groundwater hydrology and the effect of effluent on groundwater quality. (Baker-FRC)
W84-00360

EMPLOYING ACUTE AND SUBACUTE TOXICITY MEASUREMENTS IN ON-SITE BIOMONITORING STUDIES,
Weyerhaeuser Co., Tacoma, WA. Environmental Technical Dept.
J. N. Fisher.
Tappi Journal, Vol 65, No 11, p 89-91, November, 1982. 2 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Effects of pollution, *Pulp and paper industry, Industrial wastes, Fish, Toxicity, Regulations, Secondary wastewater treatment.

On-site monitoring of pulp and paper mill effluents was conducted at various sites in 1978-1980. Since installation of technology designed to comply with the Best Available Technology (BAT) requirement of the EPA designation could be costly, information was specifically sought which might indicate that a waiver could be requested from BAT installation. Pulp and paper effluents from well-operated secondary treatment systems showed little or no acute toxicity to fish. Even though raw effluent toxicity varied widely, secondary treatment systems were 90-95% efficient in removing acute toxicity. Avoidance and leucocrit responses in test fish occurred in the range of 0.4-0.7 times the median lethal concentrations. Finally, mill bioassay profile results compared with effluent instream concentrations suggest no effect on resident fish populations. (Baker-FRC)
W84-00361

THE EFFECTS OF TEMPERATURE, INLET POLLUTANT CONCENTRATION, AND MICROORGANISM CONCENTRATION ON THE RATE OF AEROBIC BIOLOGICAL TREATMENT,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
V. A. Vavilin.
Biotechnology and Bioengineering, Vol 24, No 12, p 2609-2625, December, 1982. 8 Fig, 1 Tab, 27 Ref.

Descriptors: *Wastewater treatment, *Aerobic treatment, *Mathematical models, Biomass, Biological treatment, Errors, Graphical methods, Pollution load, Model studies, Retention, Pulp wastes, Dissolved oxygen, Mathematical studies.

Traditional models used to describe aerobic waste treatment processes contain systematic errors which become manifest in broad variations of parameters such as the retention time of sewage liquid in the reactor, the biomass concentration in the reactor, the influent pollutant concentration, temperature, and dissolved oxygen concentration. A generalized model has been proposed for aerobic biological treatment that makes it possible to eliminate these systematic errors and reduce the deviation of experimental from calculated values for effluent pollutant concentration. The generalized mathematical model takes into account the pollutant concentration in the initial and purified liquid waste and the biomass in the unit volume of the reactor. Use of the proposed model is illustrated for sewage waters from paper production being oxidized in a laboratory rotating disk and by graphical methods. (Geiger-FRC)
W84-00362

DISSOLVED OXYGEN IN HYDRO PLANT DISCHARGE INCREASED BY AERATION,
A. R. Sheppard, and D. E. Miller.
Power Engineering, Vol 10, p 62-65, 1982. 7 Fig, 2 Tab.

Descriptors: *Aeration, *Dissolved oxygen, *Oxygenation, Wastewater treatment, Turbines, Powerplants, Water quality.

At the Alabama Power Company there has been successful use of a variation of a concept called draft tube aeration to increase the dissolved oxygen concentration of hydroelectric turbine discharges. This type of aeration uses the hydraulic characteristics of the draft tube to produce an air flow by means of natural aspiration. In general these systems involve the positioning of ports beneath the turbine wheel. A simple piping system vents these ports to the atmosphere, making use of the low pressure area usually found below the wheel to provide suction needed to naturally aspirate air into the draft tube. The basic concept of the system was modified by installing deflector plates upstream of the vent ports to further reduce pressure occurring at this location. These plates cause the water to separate from the draft tube wall, creating a Venturi type low pressure area just downstream of the plates, increasing the amount of air a unit can aspirate, and consequently increasing the amount of oxygen that can be added to the water. The design process involves evaluation of water quality conditions to establish DO increase target; evaluation of deflector plate/vent port configurations to optimally locate the ports and determine plate configuration to produce maximum suction pressure; simulation of the draft tube as a gas transfer rate and thus the air flow requirements; and conceptual design of a piping arrangement to provide for the intake and supply of air to the vent ports. This type of system, when applicable, is by far the most economical means of increasing DO levels of turbine discharges when compared to other methods which include molecular oxygen or mechanical aeration. (Baker-FRC)
W84-00371

IN-STREAM REAERATION OFFERS AN ALTERNATIVE TO WASTEWATER TREATMENT,
Eder Associates, Locust Valley, NY.
L. J. Eder, and W. J. Cunningham.
Tappi Journal, Vol 65, No 11, p 85-88, November, 1982. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Wastewater treatment, *Dissolved oxygen, *Pulp and paper industry, Industrial wastes, Waste disposal, Wisconsin River, Rivers, Biochemical oxygen demand, Reaeration, Aeration, Cost analysis.

Efforts are underway to amend the discharge permit issued to the Rhinelander Paper Company in Wisconsin to include waste load allocations for the maintenance of a 5.0 mg/liter dissolved oxygen standard in the Wisconsin River. The company is currently considering methods for complying with proposed BCT effluent limitations, tentatively scheduled to become effective in July 1984. Flow diversion of some effluents to their secondary treatment system along with other paper mill modifications should enable their treatment systems to produce an effluent within BCT limits. Capital costs for reducing the mill's effluent discharge to meet the most stringent waste load allocation range from $4,300,000 for spray irrigation to $11,000,000 for secondary treatment and pressure filtration of pulp and paper mill effluents. Operating and maintenance costs would increase by $300,000 with spray irrigation and by $515,000 with increased secondary treatment. In-stream reaeration appears to be the least costly method for meeting waste load allocations. The capital cost of $550,000 for a two-site system is significantly less than the advanced-treatment alternatives. Since the cost of purchased oxygen makes up a significant portion of the total annual costs, the operating cost

would probably be less than $100,000/year. Instream reaeration could be accomplished in an environmentally acceptable manner and ensure the maintenance of 5.0 mg/liter DO in the Wisconsin River. (Baker-FRC)
W84-00375

REUSING COOLING WATER IN AN ELECTRIC POWER PLANT,
Burns and McDonnell, Kansas City, MO.
For primary bibliographic entry see Field 3E.
W84-00386

RECLAMATION OF WASTEWATER CONSTITUENTS BY ION EXCHANGE, PART I - REVIEW OF FLOWSHEETS FOR THE PROCESSES,
B. A. Bolto, and L. Pawlowski.
Effluent and Water Treatment Journal, Vol 23, No 2, p 55-58, February, 1983. 5 Fig, 33 Ref.

Descriptors: *Chromium, *Cyanide, *Metal-finishing wastes, *Separation techniques, *Wastewater renovation, *Anion exchange, Industrial wastes, Wastewater treatment, Waste recovery, Recycling, Ion exchange.

When recycling metal finishing water to recover constituents, the economic value of the process increases with the amount of water recycled. Process economics depend on the concentration of the solution (the regeneration effluent recovered in the ion-exchange operation). In treating wastewaters from chrome plating, the process involves separating the suspended matter, removing organic matter, and decationizing and deanionizing the rinse water. An alternative method for the treatment of chromium rinse water is neutralization with sodium hydroxide, followed by removal of the precipitated heavy metal hydroxides and adsorption of chromate anions onto a strongly basic anion exchanger. By implementing engineering changes, a significant improvement is obtained with the use of a counter-current fixed bed system based on a very short column. In the regeneration of cyanide plating wastewater, a three-column system consisting of a strongly acidic cation exchanger followed by a weakly basic anion exchanger and a strongly basic anion exchanger has been successful. The regeneration of the anion exchanger is performed with caustic soda in a counter-current manner. Theoretically, recycling of the regeneration effluent is practicable only when the cyanide rinse water, which is separated, contains only the metals present in the original bath. (Geiger-FRC)
W84-00392

FIRST IMPRESSIONS OF A NOVEL AERATION SYSTEM FOR ACTIVATED SLUDGE PLANTS,
A. P. Hopwood, and L. M. Barnes.
Effluent and Water Treatment Journal, Vol 23, No 2, p 62-65, 67-70, February, 1983. 3 Fig, 8 Tab, 15 Ref.

Descriptors: *Aeration, *Model studies, *Contact stabilization, *Activated sludge process, Organic loading, Wastewater treatment, Nitrification, Contact beds, Suspended solids, Respiration, Activated sludge, Biological oxygen demand.

The contact stabilization plant at Isleham, which is part of the Water Authority, was modified with a new aeration system according to different Venturator models to accept a higher organic loading. After a four month trial period, it was noted that a dissolved oxygen concentration of over 1 milligram/liter could be maintained with vigorous mixing and aeration. Respiration rate measurements showed that the oxygenation capacity of Venturators in a full-scale activated-sludge plant were equal to or better than their previously assessed performance in clean water. The plant effluent contained an average of 15 milligrams/liter suspended solids and 19 milligrams/liter of biological oxygen demand (BOD). BOD removal was 92.2-97.6% and nitrification was nearly 50%. The carbonaceous respiration rate was determined as an average of 1.36 kilograms oxygen utilized per kilogram BOD applied. High sludge-growth rates were observed on the order of 0.92 kilograms of sludge produced per kilogram of BOD applied due to organic load and the use of macerated whole sewage. (Geiger-FRC)
W84-00404

TECHNOLOGY FOR THE REMOVAL OF SYNTHETIC ORGANIC COMPOUNDS,
Ontario Ministry of the Environment, Toronto.
N. W. Schmidtke, and S. A. Black.
Effluent and Water Treatment Journal, Vol 23, No 2, p 47-50, 52-54, February, 1983. 7 Fig, 14 Tab.

Descriptors: *Wastewater treatment, *Organic compounds, *Activated carbon, *Separation techniques, Water treatment, Drinking water, Water pollution sources, Waste disposal, Advanced wastewater treatment, Tertiary wastewater treatment.

The problems caused by synthetic organic compounds (SOCs) in water supplies are numerous and are still being assessed. Research is being done to improve the analytical sensitivity required to detect SOCs in water, wastewater and sludges. Nevertheless, the application of any one single technology will not be the answer to any one SOC problem. However, activated carbon treatment will most likely play an important part in the control of SOCs. Technology for the control of SOCs in drinking water supplies is focusing on the enhancement of existing processes and reuse and reformulation options. The application of stringent in-plant process controls along with careful waste disposal selection is the most cost-effective means of ensuring that only minimum quantities of SOCs will escape in process effluents, enter the environment and require further treatment. (Geiger-FRC)
W84-00405

EVALUATION OF BIOMASS AGE IN ACTIVATED SLUDGE PROCESSES,
Rome Univ. (Italy). Cattedra di Principi di Ingegneria Chimica.
M. C. Annesini.
Water, Air, and Soil Pollution, Vol 19, No 1, p 55-61, 1983. 4 Fig, 7 Ref.

Descriptors: *Activated sludge process, *Aging, *Biomass, Wastewater treatment, Sludge, Sludge conditioning, Mathematical equations.

A general formulation is presented for expressing biomass age that may be used regardless of aeration tank set up. In this criterion the biological reaction may be likened to completely mixed reactors operated in series. Expressions for a single-unit reactor have been deduced from the general expression, and these are shown to be equivalent to those reported in the art, and for plug flow reactor. An examination of multi-stage processes without recycle shows that whenever the overall effect of phenomena connected to biomass growth is negative biomass age can be deduced from the volumetric residence times of the single reactors. (Baker-FRC)
W84-00428

TREATMENT OF BLUE CRAB PROCESSING PLANT WASTEWATER USING PHYSICAL, CHEMICAL AND BIOLOGICAL PROCESSES,
Maryland Univ., College Park. Dept. of Agricultural Engineering.
E. L. Geiger, F. W. Wheaton, and R. B. Brinsfield.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120856, Price codes: A08 in paper copy, A01 in microfiche. Water Resources Research Center Technical Report No 71, August 1983. 142 p, 27 Fig, 17 Tab, 71 Ref, 2 Append. OWRT A-056-MD(1), 14-34-0001-2122.

Descriptors: *Wastewater treatment, *Wastewater analysis, *Effluents, *Processing plants, Chemical coagulation, Foam fractionation, Ultraviolet radiation, Biological wastewater treatment, Sand filters, Activated carbon, Adsorption.

A treatment system for wastewater from a blue crab processing plant consisting of a biological reactor, sand filter and an activated carbon column was evaluated. Various retention times and dilutions of retort effluent were used to assess reduction of dissolved organics and solids following biological treatment. The necessity of utilizing activated carbon adsorption in conjunction with sand filtration to produce an effluent suitable for UV disinfection was evaluated. These tests indicated: (1) 24-hour batch biological treatment of 5% retort effluent resulted in a mean reduction of 88% in biochemical oxygen demand (BOD sub 5), 86% in chemical oxygen demand (COD), and 29% in total suspended solids (TSS) and produced an effluent with a mean UV transmission of 30%; (2) hourly addition of 5% retort effluent to the reactor during the first 8 hours resulted in reduction of 92% in BOD sub 5 and 90% in COD, 23% in TSS and produced an effluent with a UV transmission of 35% after a 24-hour reaction time; (3) biological treatment using intermittent addition of 1% dilution of retort effluent resulted in organic reduction of 99% in BOD sub 5, 92% in COD, 9% in TSS, and produced an effluent with a UV transmission of 72%. The organics and solids concentrations in the 1% intermittent addition system were reduced sufficiently to allow UV treatment without the use of activated carbon adsorption.
W84-00435

DETERMINATION OF ALGAL-BACTERIAL INTERACTIONS IN WASTEWATER TREATMENT LAGOONS,
Northern Arizona Univ., Flagstaff. Dept. of Biology.
H. Speidel, F. Colwell, and D. Blinn.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120898. Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center Completion Report, Tucson, Ariz. September 1983. 66 p, 13 Fig, 16 Tab, 65 Ref. OWRT A-113-ARIZ(1), 14-34-0001-2103.

Descriptors: Microbial ecology, *Algal-bacterial interactions, Lagoons, *Wastewater treatment, *Oxidation ponds, Chlorella vulgaris, Escherichia coli, Bacterial survival.

The primary objective of this study was to determine whether algae present in wastewater oxidation ponds either enhance or inhibit the survival of pathogenic or indicator bacteria commonly found in wastewater. Population dynamics were studied for pond isolated axenic algae and bacteria in culture together and alone to note whether interactions may be obvious in terms of cell division or survival. Algal-free filtrates from algal cultures were inoculated with bacteria to assess the need for direct contact of interacting organisms. A variety of bacteria and algae were also grown on double-sided plates to allow diffusion of possible extracellular products. In situ studies involved the suspension of bacteria within dialysis bags followed by placement of bags in wastewater lagoons or separation of bacteria from pond water by cellulose acetate membranes in parabiotic tubes. When cultured in the presence of Chlorella vulgaris, Escherichia coli exhibited an increased rate of dieoff relative to the control or when cultivated with Scenedesmus longus. Growth of unialgal, nonaxenic Scenedesmus sp. on double-sided plates was enhanced when cultivated opposite a Pseudomonas sp. Growth of this same alga was inhibited when other bacteria were established. Results of the cocultures of Chlorella vulgaris-Escherichia coli and double-sided plates suggest that the interactions of selected algae and bacteria occur although these are controlled situations and difficult to compare to the complex conditions of a eutrophic pond. Additionally, the double-sided agar plate offers a new method for rapid screening of potential microbial interactions.
W84-00439

APPLICATION OF REVERSE OSMOSIS TO AUTOMOTIVE ELECTROCOAT PAINT WASTEWATER RECYCLING,
Ford Motor Co., Dearborn, MI. Engineering and Research Staff.
For primary bibliographic entry see Field 3A.
W84-00460

A CRITICAL REVIEW OF FOULING OF REVERSE OSMOSIS MEMBRANES,
Rutgers - The State Univ., Piscataway, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 3A.
W84-00467

UTILIZATION OF WASTE OF HOT WATER FOR DISTILLATION,
Indian Inst. of Tech., New Delhi. Centre of Energy Studies.
For primary bibliographic entry see Field 3A.
W84-00476

RESURRECTION OF DEIGHTON SEWAGE TREATMENT WORKS,
Yorkshire Water Authority (England). Western Div.
C. N. L. Cree.
Water Pollution Control, Vol 82, No 1, p 87-101, 1983. 8 Fig, 2 Ref.

Descriptors: *Sludge disposal, *Rehabilitation, *Industrial wastewater, Wastewater treatment, Deighton Sewage Plant, Huddersfield, *United Kingdom, Sludge digestion, History, Maintenance, Wool wastes.

The Deighton Sewage Treatment Works downstream of Huddersfield on the River Colne, United Kingdom, started with primary sedimentation and sand filtration in 1876. After a series of alterations and additions to accommodate the wastes from the many woolen factories nearby, the sludge treatment facility was declared unrepairable in 1972. The water authority reorganization in 1974 opened the way for improvement of the many deficiencies in the plant: a permanently open inlet control penstock, clogging of the entire system with septic sludge, lack of grit removal, an overflowing sludge tip, constant overflows of untreated sewage into the river, and toxic chemical wastes from industrial dischargers. Some of the problems were solved by improving plant maintenance, replacement of the inoperative penstock, disposal of the humus sludge at sea, removal of excess chemical sludge to a spare bioaeration plant, installation of two sets of vertical bar screens, continuous shift work in the sludge dewatering facility, updating of filter presses, reprofiling the sludge tip, and control of toxic wastewater in influent. (Cassar-FRC)
W84-00479

WHAT MAKES A SLUDGE COLLECTOR DRIVE TICK.,
Envirex, Inc., Waukesha, WI.
E. P. Saffran.
Water/Engineering and Management, Vol 130, No 1, p 24-25, 28, 45, 1983. 1 Tab.

Descriptors: *Sludge, Mechanical equipment, Wastewater treatment, *Wastewater treatment facilities, Drive, Gears.

The most widely used circular collectors are scraper-type clarifiers and thickeners, suction-type sludge removal units, and process combination collectors. In the scraper-type units, scraping blades are attached to a rotating truss. The blades convey the sludge radially to the center of the collector, where it is removed either by a sludge pump or by hydrostatic pressure. The gravity thickener is a scraper-type collector which allows the sludge to settle and thicken. The circular collector becomes an efficient secondary clarifier when its sludge-removal mechanism is modified. A circular collector has either a peripheral drive or a center drive. There are two types of center drives; the full bridge and the half bridge. The gearhead is the heart of the system. In practical, operational terms an underdesigned bearing may cost less than $10 to replace. The job of installing a new one may take less than 3 hr. However, a complete replacement gear will cost several thousand dollars and will take several days to replace. The various parts and elements of the gearhead must be compatible. The design life of the drive, the gears, the bearings and the rotating structure must all be balanced to achieve the specified performance over the specified lifespan. The proper balance can reduce capital investment and operating costs. It can help ensure the high dependability that is needed in systems which treat municipal and industrial wastewater. (Baker-FRC)
W84-00484

INFLOW DISTRIBUTION IN WASTEWATER COLLECTION SYSTEMS,
RJN Environmental Associates, Inc., Wheaton, IL.
A. J. Hollenbeck, and R. J. Nogal.
Water/Engineering and Management, Vol 130, No 1, p 30-33, 1983. 2 Fig, 7 Tab, 4 Ref.

Descriptors: *Wastewater collection, *Flow characteristics, *Sewer systems, Infiltration, Inflow, Monitoring, Measuring instruments.

Analysis of actual field-verified inflow data for several sewer system evaluation surveys points to certain conclusions regarding the inflow component of infiltration and inflow (I/I) sources in sanitary sewer systems. Inflow appears in general not to be highly concentrated in small parts of a collection system, but rather evenly distributed. It is independent of the flow monitoring interval used to isolate inflow sources. Elimination of large parts of a sanitary sewer system from field survey activities could result in not identifying up to 50% of the largest inflow sources. Inflow reduction is proportional to the extent of the field survey work performed. Rehabilitation by priority can be part of an annual operation and maintenance program. The identification and reduction of excessive flow in a sewer system is complex and is just beginning to be understood by the technical community. It would be inappropriate to abandon the program or search for shortcuts that will not accomplish the stated goals and desired objectives of the I/I reduction and rehabilitation efforts. (Baker-FRC)
W84-00485

TRAINING MAKES ENFORCEMENT EASIER,
Minnesota Pollution Control Agency, Roseville.
G. A. Erickson, and M. W. Herman.
Water/Engineering and Management, Vol 129, No 12, p 24-26, 1982. 4 Tab.

Descriptors: *Wastewater treatment, *Training, *Management, Decision making, Education, Regulations, Enforcement.

The Minnesota Pollution Control Agency was established in 1967 and given authority to administer and enforce all laws relating to water, air and land pollution within the state. Enforcement was used as the main tool in achieving compliance with prescribed standards. To aid in personnel training the agency implemented an operator assistance program in 1976. Its principal objective was to train operators in process control. This would improve their skills and enhance their ability to produce consistently high quality effluent. Selection of a plant for an assistance project basically involves two situations. The facility may be having operational problems causing it to be in noncompliance, or it may currently be in compliance but is approaching the point of being in violation because of difficulties. Since the onset of the program 30 major projects have been completed. Of those 30, four were not successful. Two of these were because of uncooperative operating or municipal officials, while the other two were because the facility would not show any significant improvement in effluent quality. Two thirds of the completed projects involved activated sludge plants in which the major problem was lack of a process control program or interpretation of one already in existence. The remaining third of the projects were carried out at trickling filter plants and controlled discharge stabilization ponds. The time for project completion varied from a minimum of five months to a maximum of 30 months, with an average time of 14 months per project. (Baker-FRC)
W84-00487

ESTIMATING WASTE ACTIVATED SLUDGE,
Clemson Univ., SC.
L. G. Rich.
Water/Engineering and Management, Vol 129, No 12, p 35, 1982. 1 Tab.

Descriptors: *Estimating equations, *Activated sludge process, *Wastewater treatment, Mathematical equations, Suspended solids, Estimating, Flow rates.

The estimating of waste activated sludge quantities has long been neglected in the wastewater treatment field. Two quantities are of basic importance: the daily production rates of total solids and of biodegradable solids. Equations are derived for situations in which no pretreatment is given to the wastewater. In cases where pretreatment is offered, the characteristics of the pretreated wastewater are used in place of those of the influent wastewater. The concentration of inert solids remaining in the wastewater after 30 days aeration at room temperature can be determined in a batch mode using an Imhoff cone fitted with aeration tubing. In making the determination it is important to replace the water that evaporates from the system on a daily basis. Aeration should be conducted in the dark to suppress algal growth. The volumetric flow rate at which waste activated sludge is processed through a sludge treatment train is also of considerable importance in design. The concentration of solids in waste activated sludge withdrawn from the underflow of the secondary clarifier will normally vary between 7,000 and 10,000 mg/liter. (Baker-FRC)
W84-00489

SOLUTION TO ODOR PROBLEM GIVES UNEXPECTED SAVINGS,
Saratoga County Sewer District No. 1, Mechanicville, NY.
D. J. Rudolph.
Water/Engineering and Management, Vol 129, No 12, p 28-29, 1982.

Descriptors: *Wastewater treatment, *Odor control, *Permanganate, Hydrogen sulfide, Sulfuric acid, Corrosion, Odors, Sewer systems, Cost analysis, Sludge dewatering.

The Saratoga county wastewater treatment plant was seeking a solution to an odor problem. During a study of the system district personnel discovered that the chemical, potassium permanganate, not only took care of the odor nuisance but also produced unexpected cost savings in the sludge dewatering department. The odor problem had been most prevalent at three pumping stations that range in load from about 500,000 gpd down to about 60,000 gpd. Hydrogen sulfide concentrations in the atmosphere during the summer were greater than 100 ppm and varied down to 50-60 ppm at times of light usage. Not only was the odor a problem, but the oxidation of hydrogen sulfide in the atmosphere to sulfuric acid caused corrosion of mild steel equipment and copper contacts of electrical systems. The permanganate is now added at the three pumping stations using dry feeders equipped with slurry modules. The resulting $KMnO_4$ solution is metered into the wet wells directly to the influent sewage. Average dosage is about 20-25 lb/mil gal, and total consumption for the collection system amounts to about 125 lb/day. The permanganate reacts very quickly with hydrogen sulfide, and very little gas is now released to the atmosphere from the cascading sewage. Total processing savings are truly significant. It used to cost $209 to process a dry ton of cake. Today that cost is $65. (Baker-FRC)
W84-00491

STUDIES ON ALKALINE EARTH SULFITES - III(1). TRANSIENT SOLUBILITIES AND PHASE CHANGES OF CALCIUM SULFITE IN SEAWATER,
For primary bibliographic entry see Field 3A.
W84-00504

THE BOWHOUSE SEWERAGE AND SEWAGE DISPOSAL SCHEME OF FIFE REGIONAL COUNCIL,
K. C. Wilson.
Water Pollution Control, Vol 82, No 1, p 42-48, 1983. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Oxidation ditches, *Ditches, *Wastewater treatment, Storage tanks, Bowhouse Sewage Treatment Plant, *Scotland.

Existing sewage treatment works at three towns in Scotland (Ladybank, Auchtermuchty, and Falkland) were replaced with an oxidation ditch system, centrally located at Bowhouse. The ditch capacity is 1396 cu m; retention time, 27.65 hours. The system also contains settlement tanks and clarifier, activated sludge storage tanks, and septic tank sludge storage tanks. Final effluent since the initial runs has had < 10 mg per liter BOD and < 10 mg per liter suspended solids. (Cassar-FRC)
W84-00511

THE USE OF OXYGEN TO UPRATE THE TREATMENT CAPACITY OF A CONVENTIONAL SURFACE-AERATION PLANT AT HOLDENHURST (BOURNEMOUTH) SEWAGE-TREATMENT WORKS,
M. Robinson, R. A. Varley, and A. R. Kimber.
Water Pollution Control, Vol 82, No 1, p 49-51, 1983. 4 Tab.

Descriptors: *Oxygen, *Nitrification, *Odor control, Wastewater treatment, Holdenhurst Sewage Treatment Works, *United Kingdom, Oxidation, Aeration.

Corrections and additional tables are presented for the above titled paper, published by the same authors in Water Pollution Control, Vol. 81, No. 3, page 391. Liquid oxygen was used at the Holdenhurst Sewage Treatment Plant, United Kingdom, to uprate overloaded nitrification and carbonaceous aeration lanes and to suppress odors. This was accomplished by either side stream, in-pocket, or direct injection, depending on the location. The average treatment efficiency was 1.08 kg 02 supplied per kg BOD removed, an improvement from the earlier 1.46 kg per kg value. (Cassar-FRC)
W84-00512

WET OZONATION FOR THE TREATMENT OF SEWAGE-TREATMENT WORKS ODOURS,
R. Anderson, and G. F. Greaves.
Water Pollution Control, Vol 82, No 1, p 18-20, 1983. 1 Fig.

Descriptors: *Odor control, *Ozonation, *Sewage gas, Oxidation, Chlorination, *Wastewater treatment, Sulfides.

An odor control program in a sewage treatment works should include adequate ventilation, usually 5 to 10 air changes per hour, close-fitting tank covers, and treatment of odorous gases. Sewage odors arise from some or all of the following compounds: hydrogen sulfide, methyl mercaptans, methyl sulfides, amines, fatty acids, alcohols, and ketones. Treatment methods such as acid and alkaline scrubbing and chlorine oxidation usually do not eliminate all the odorous compounds. However, ozonation will destroy all the above compounds at all expected pH and temperature variations. (Cassar-FRC)
W84-00513

THE BIOENERGY PROCESS--AN OVERVIEW,
G. M. Rippon.
Water Pollution Control, Vol 82, No 1, p 29-36, 1983. 6 Fig, 3 Tab.

Descriptors: *Anaerobic conditions, *Industrial wastewater, *Contact process, *Wastewater treatment, *Bioenergy process, Activated sludge process, Biomass, Settling tanks, Methane.

The Bioenergy process, a variant of the anerobic contact process, was created in 1974. A thermal shock applied to the anaerobic biomass just prior to entry to the settling tank prevents gassing which normally occurs at this step. This approach produces high separation efficiency. Effluents of 1000 to 60,000 mg BOD per liter may be effectively treated. Compared with the activated sludge process the Bioenergy process has reactors half as large, requires only 1/7 the energy, has settlers twice as large, produces 1/10 the sludge, and generates 0.5 tons of fuel per ton BOD applied. In a series of industrial wastewaters treated, BOD removal was 90-99%; COD removal, 83-98%. The Bioenergy process overcame high sulfate concentrations, trace element deficiencies, high ionic strength, nutrient deficiencies and overloads, high concentrations of nonbiodegradable solids, low alkalinity, and salt crystallization in the heat exchangers. (Cassar-FRC)
W84-00514

HYDRAULIC AND GEOLOGICAL PROBLEMS OVERCOME AT BOBCAYGEON'S WATER AND SEWAGE TREATMENT PLANTS,
For primary bibliographic entry see Field 5F.
W84-00515

TESTS ON AERATORS: CONCLUSIONS DRAWN FROM 500 CLEAN WATER TESTS CONDUCTED IN 200 DIFFERENT SEWAGE TREATMENT PLANTS--II. DATA INTERPRETATION (ESSAIS D'AERATEURS: ENSEIGEMENTS TIRES DE 500 ESSAIS EN EAU CLAIRE EFFECTUES DANS 200 STATIONS D'EPURATION DIFFERENTES-II. RESULTATS),
Centre National de Machinisme Agricole du Genie Rural, des Eaux et des Forets, Paris (France).
A. Heduit, and Y. Racault.
Water Research, Vol 17, No 3, p 289-297, March, 1983. 6 Fig, 6 Tab, 4 Ref.

Descriptors: *Aeration, *Oxygenation, *Performance evaluation, *Wastewater treatment, Bubbles, Error analysis, *France.

Aerator tests at sewage treatment plants in France revealed that oxygenation capacities predicted by the manufacturers were close to observed values. In a well mixed tank, using the correct procedure, the relative error in measuring specific oxygen input was 5%. Under less favorable operating conditions, the error was 10%. Average specific oxygen inputs in clean water using different aeration systems ranged from 0.6 to 2.5 kg 02 per kWh. Highest values were obtained with fine bubbles and mechanical agitation. Relationships between oxygenation capacity and specific power consumption are plotted. (Cassar-FRC)
W84-00516

THE CULTIVATION OF ALGAE USING WASTE WATER FROM FEEDLOTS,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
A. J. H. Pieterse, J. LeRoux, and D. F. Toerien.
Water SA, Vol 8, No 4, p 202-207, 1982. 7 Fig, 5 Tab, 41 Ref.

Descriptors: *Animal wastes, *Algal growth, *Waste disposal, Aquaculture, Algae, Water pollution control, Water pollution sources, Wastewater treatment, Ponding, Fecal contamination, Bacteria, Cattle feedlots, *Feedlot runoff.

The cultivation of algae in ponded wastewater from a cattle feedlot is described. Treatment is aimed at organic and inorganic wastes produced by animals such as cattle which, for economic and other reasons, are kept in confinement units. Massive amounts of waste material consisting of urine and feces are produced in a concentrated point-source form in these confinement units. Waste materials are usually removed by wash or flush water, representing a major source of environmental pollution with significant health and aesthetic consequences. The largest cattle feedlot system in South Africa contains approximately 30,000 animals, producing waste equivalent to that of a city of 180,000 to 300,000 people. As a matter of urgency consideration must be given in South Africa to the development and application of integrated livestock waste treatment production systems to reduce this pollution. In this study an annual average algal production rate of 10 g/sq m/day of dried algal material was achieved, while a reduction in inorganic nitrogen and phosphorus concentrations in excess of 90% was maintained in a high rate algal pond supplied with feedlot effluent. These results indicate that the algal pond concept can be used efficiently under South African conditions; further study is needed to optimize such a treatment/production system. (Baker-FRC)
W84-00525

THE DESIGN AND CONSTRUCTION OF SPRINGFIELD SEWAGE-TREATMENT WORKS,
Fife Regional Council (Scotland).
J. G. Moore.
Water Pollution Control, Vol 82, No 1, p 37-41, 1983. 1 Fig, 2 Tab.

Descriptors: *Animal wastes, *Municipal wastewater, *Sludge disposal, Wastewater treatment, Springfield, *Scotland, Dewatering, Farm wastes, Filters, Sludge digestion, Land application.

A sewage treatment works was built for the Springfield, Scotland, region, population 7000, which included several sources of problem wastes: a hospital, a college farm, a piggery, an abattoir, and an oatmeal factory. The system contained primary settlement and storm tanks, percolating filters, humus tanks, and sludge holding tanks. A filter belt press was chosen for sludge dewatering. Most disposal of sludge is on farmland; some sludge is being mixed with fly ash for landscaping fly ash lagoons. The new treatment system replaced an overloaded and poorly serviced settlement tank and direct discharge of the industrial effluents to the River Eden. (Cassar-FRC)
W84-00529

WATER, THE ESSENCE OF LIFE - AN INTERNATIONAL CONGRESS ON DESALINATION AND WATER REUSE,
CH2M Hill Southeast, Inc., Gainesville, FL.
For primary bibliographic entry see Field 3A.
W84-00532

AN OVERVIEW OF DIGESTION PROCESSES,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
W. A. Pretorius.
Water Science and Technology, Vol 15, No 1, p 1-6, 1983. 3 Fig, 13 Ref.

Descriptors: *Digestion, *Methane bacteria, *Anaerobic digestion, *Wastewater treatment, Sludge digestion, Fermentation, Bacteria, Acetic acid, Fatty acids.

Anaerobic digestion of concentrated wastes relies on the highly specialized methane bacteria to convert organic matter to methane. The process has some disadvantages: the complexity of the bacterial mechanisms and resulting difficulty in process control, low growth rate of bacteria at ambient temperatures, and the necessity for further treatment of effluent before discharge. Methane bacteria include representatives of nearly all basic forms of bacteria. They have in common the ability to oxidize molecular hydrogen to methane in the absence of oxygen. About 70% of the methane formed proceeds through an acetic acid intermediate step. It is possible that methanogenesis proceeds through a dual- or multi-step mechanism involving several types of bacteria and chemical reactions, such as hydrolysis, fermentation, acetate decarboxylation, and methanogenesis. Basic designs of anaerobic digestors include conventional (for sewage sludges and animal wastes), contact process (dilute and soluble biodegradable wastes from such places as meat packing plants), filters (for acetic acid-containing wastewaters), and upflow sludge blanket reactor (for dilute starchy washwaters). (Cassar-FRC)
W84-00552

ENERGY OPTIMIZATION IN SEWAGE AND SLUDGE TREATMENT,
Ruhrverband, Essen (Germany, F.R.).
K. R. Imhoff.
Water Science and Technology, Vol 15, No 1, p 103-114, 1983. 11 Fig, 4 Tab, 2 Ref.

Descriptors: *Sludge digestion, *Energy, *Activated sludge process, *Wastewater treatment, Incineration, Sludge disposal, Costs, Digestion.

The energy requirements of three wastewater treatment systems in Germany are described. Present BOD-population equivalents and energy demands are as follows: Bochum-Olbachtal, 150,000 and 14.4 million kWh per year; Hagen, 270,000 and 6.1 million kWh per year; and Duisburg (proposed plant), 510,000 and 4 million kWh per year. Bochum consists of a conventional activated sludge plant, polishing lagoons, dewatering and incineration of primary sludge, and digestion and incineration of waste activated sludge. Incineration requires 65.5% of the energy used at the plant. The Hagen system is comprised of primary sedimentation, activated sludge, sludge dewatering, and sludge dumping at a 45% solids content. About 75% of the energy used at Hagen is consumed in the activated sludge process and the trickling filters. The proposed Duisburg-Kasserfeld plant will use diffused air activated sludge treatment with sludge thickening, dewatering, and dumping. Diffused aeration will require 51% and other biological treatment 18% of the energy. (Cassar-FRC)
W84-00553

EFFLUENT TREATMENT AND PROTEIN RECOVERY IN EAST ANGLIA.
Water Services, Vol 86, No 1041, p 536-7, 1982. 2 Fig.

Descriptors: *Wastewater treatment, *Food processing wastes, *Wastewater treatment facilities, *Poultry, East Anglia, Protein recovery, Industrial wastes.

Primary considerations in designing a suitable plant for handling an effluent with a COD of almost 4000 mg/liter and a suspended solids content of 1200 mg/liter, apart from meeting the effluent standards, were the availability of space and the minimization of sludge for off-site disposal. Wastewater is collected in an underground sump and pumped by submersible pumps to a screen mounted above a circular balance tank. Wastewater is then pumped to a circular dissolved air flotation tank constructed in glass reinforced plastic; in line to the flotation tank a specific protein precipitant, lignosulfonate, is added. The pH is reduced to 3 by the addition of sulfuric acid. A fraction of the wastewater is diverted from the pipeline to the flotation tank, and part is saturated with air at five atmospheres pressure. The air dispersion water rejoins the main flow at the inlet to the flotation tank, where microscopic air bubbles are precipitated. These adhere to thee protein/fat flocs and carry them to the surface of the flotation tank, where they are removed by a rotating suction arm. The flotated sludge has a total solids concentration of about 10%. The plant occupies a total area of about 300 sq m and can be operated by one person on a part time basis. (Baker-FRC)
W84-00559

CONTROL AND AUTOMATION SYSTEM FOR WITNEY SEWAGE TREATMENT WORKS,
B. E. Marsh.
Water Services, Vol 86, No 1042, p 586-588, 1982. 2 Fig.

Descriptors: *Wastewater treatment facilities, *Automation, *Data acquisition, Instrumentation, Witney Sewage Treatment Works, Thames Water Authority, Computers, *England.

The Wesdac Supervisory Control and Data Acquisition system to be supplied to meet the specified requirements of the Thames Water, consisting of a conventional Wesdac 6 control center and 10 advanced technology outstations, is described. The total modernization of the Western Division of the Thames Water Authority was undertaken with the objective of increasing its throughput from 3700 to 7800 cubic meters/day. Although it was built on the site of an existing sewage treatment works, only the primary sedimentation tanks were retained in changing the process from filter beds to activated sludge. The final phase of the scheme will be installation of instrumentation, control and automation systems providing the following functions: process controllers dedicated to specific items of plant in each of the primary and secondary treatment areas; a central computer coordinating all local controller and centralizing all plant process measurements; visual display terminals distributing the relevant level of process information to operational and management staff; and the facility as a whole acting as a proving ground for computer based systems for the management of sewage treatment processes and providing instrumentation evaluation facilities in conjunction with the Water Research Center. The flexibility of the intelligent outstations enables a wide range of system functions to be implemented: interfacing to new or existing instrumentation, scanning analog and digital data from the plant into a data base held in the outstation, generating local control output commands for the area of plant under its control, and controlling the flow balancing and aeration areas. It is possible to expand the outstation database to include the facility to hold derived analog and digital data. (Baker-FRC)
W84-00562

ADVANCES IN THE TREATMENT OF LIQUID-BORNE SOLID WASTE.
Water Services, Vol 87, No 1043, p 25-26, January, 1983.

Descriptors: *Solid wastes, *Shredders, Waste treatment, *Wastewater treatment, Mono Muncher, Equipment.

The Mono Muncher is effective in macerating solid debris entering sewage treatment plants. This low-speed disintegrator consists of two parallel, contra-rotating shafts with opposed intermeshing teeth set on cutter discs. The shredding action efficiently reduces nylon, timber, plastic, rags, and metal cans. An exceptionally large object will cause the cutters to reverse in an effort to clear the blockage. If this fails, the system shuts down automatically. Energy consumption per cu m of sludge is 0.01-0.02 kW compared with 0.2-0.44 kW for conventional macerators. The Muncher is especially useful in small plants, for which screens are impractical. Pipeline, channel, and submersible models are available. (Cassar-FRC)
W84-00564

DISCUSSION OF: ROLE OF ADSORPTION IN BIOLOGICAL EXTENDED ACTIVATED CARBON COLUMNS, AND AUTHOR'S RESPONSE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittman, S. J. Randtke, J. D. Lowry, and C. E. Burkhead.
Journal of the Water Pollution Control Federation, Vol 53, No 4, p 512-514, April, 1981. 2 Tab, 7 Ref.

Descriptors: Secondary wastewater treatment, *Activated carbon, *Water treatment, *Wastewater treatment, Adsorption, Potable water.

Comments are presented on the above titled paper by J. D. Lowry and C. C. Burkhead, published in Journal of the Water Pollution Control Federation, Vol. 52, p 389, 1980. Although the discussors agree that adsorption of organics on activated carbon does not enhance biological activity when substrate concentrations are high and oxygen is limiting, they state that the paper does not prove that the opposite case (low substrate concentrations or oxygen not limiting) is true. Therefore, the conclusions cannot be extrapolated to the activated carbon treatment of well-treated secondary effluent or potable water supplies. The author responds that a closer review of his work would indicate that the work is intended only for application to the secondary level of treatment. He cites a reference which concludes that the higher bacterial colony counts on activated carbon are not due to adsorption of organic compounds but to the larger surface area per unit volume of media as compared with nonactivated carbon or sand. (Cassar-FRC)
W84-00570

HEALTH ASPECTS OF WASTEWATER AEROSOLS,
Health Effects Research Lab., Cincinnati, OH.
H. R. Pahren, and W. Jakubowski.
Water Science and Technology, Vol 13, No 4/5, p 1091-1096, 1981.

Descriptors: *Aerosols, *Public health, *Microorganisms, Wastewater pollution, Air pollution, Epidemiology, Viruses, Bacteria, Pathogens, Enteric bacteria, Path of pollutants.

Investigations sponsored by the EPA revealed no adverse health effects from wastewater aerosols in persons living or working near wastewater treatment plants. Two studies were retrospective: (1) 7 years of data on the respiratory and gastrointestinal illnesses of persons living within 600 meters of a sewage plant at Tecumseh, Michigan, and (2) illness rates of elementary school students whose playground was 50 meters from the aerated surge basin of a treatment plant. Epidemiological studies were as follows: 4200 persons living near a new 64,000 cu meters per day activated sludge plant in Illinois were questioned regarding illnesses and health status, and clinical specimens from 282 persons were examined, (2) a group of 2378 persons and a group of wastewater plant operators at a 1 million cu meters per day treatment plant in Chicago were studied, and (3) newly employed activated sludge plant workers and controls in Chicago, Cincinnati, and Memphis were evaluated by detailed medical tests. Although viable microorganisms were detected in air near the treatment plants, comparisons of illness rates and health status of exposed persons were not statistically different from control groups with the exception of a slight increase in mild gastrointestinal illnesses in inexperienced sewage plant workers during the first few months of employment. Several reasons for the lack of statistical differences in illness rates are suggested, including exposure levels below the minimum infective dose, respiratory exposure to enteric microorganisms, and nonspecific immunity. (Cassar-FRC)
W84-00591

SHORT-TERM LOW AS WELL AS HIGH TEMPERATURE OPERATION OF AN MSF PLANT USING BELGARD EVN AS A SCALE CONTROL ADDITIVE,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
F. H. Butt, and A. H. Bou-Hassan.
Desalination, Vol 42, No 1, July 1982, p 79-86, 2 Tab, 4 Fig, 2 Ref.

Descriptors: *Desalination, *Multistage flash, *Scaling, Belgard EVN, Distillation.

During a 40-day low temperature trial, conducted in 1979 using 2.0 ppm of Belgard EVN, the GOR ranged between 10.9 and 9.9 as against the design value of 8.0, while the heater fouling factor (FF) rose gradually from 0.00002 to 0.00007 sq m deg C/W. A polyphosphate trial, carried out in 1978 on the same MSF plant, showed the rate of fouling of heater tubes to be four times that during the Belgard EVN trial. During the polyphosphate operation, the heater FF had in the same period climbed from 0.00018 to 0.00070 sq m deg C/W. In 1980, the top brine temperature of the unit was progressively increased from 87.8 to 104.4C, while increasing the Belgard EVN dosage from 2.5 to 6.0 ppm. The GOR increased from 8 to 9 up to a top brine temperature of 98.9C and then declined to about 7.7. The heater FF increased gradually from 0.00010 to 0.00019 sq m deg C/W.
W84-00619

CROSS-CURRENT FLOTATION FOR METAL REMOVAL FROM PLATING WASTES,
Rhode Island Univ., Kingston. Dept. of Chemical Engineering.
S. M. Barnett, F. J. DeLuise, and E. Nir.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132539, Price codes: A02 in paper copy, A01 in microfiche. Water Resources Center Technical Report No 12, September 1983. 11 p, 3 Tab, 11 Ref. OWRT A-077-RI(1), 13-34-0001-2142.

Descriptors: *Foam separation, *Flotation, Wastewater treatment, *Metal-finishing wastes, Heavy metals, Chromium, Zinc, Nickel, Lead.

While countercurrent flotation pilot plants have been shown to be effective and economical in removing metals such as cobalt, copper, lead, zinc and iron by means of various precipitate flotation techniques, many plating facilities have troughs or other horizontal conduits which would make flotation more economically attractive if these existing channels could be adapted for such use. The purpose of this study was to investigate the feasibility of crosscurrent precipitate flotation for these troughs. The metals investigated were copper, nickel and lead. The most important trend found in the results is that the shorter trough more effectively removes metals by precipitate flotation for a given pH and given flow rates than the longer trough. Thus, the horizontal flotation process should be done over a minimum length to avoid undersized enrichment of the water due to foam breakage.
W84-00640

IN-SITU AND ON-SITE BIODEGRADATION OF INDUSTRIAL LANDFILL LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
For primary bibliographic entry see Field 5E.
W84-00686

5E. Ultimate Disposal Of Wastes

COMMUNITY PLANNING FOR LAND APPLICATION,
Georgia Univ., Athens. School of Environmental Design.
B. K. Ferguson.
Biocycle, Vol 23, No 5, p 45-49, 1982. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Land disposal, *Water reuse, *Environmental effects, Heavy metals, Pennsylvania, Cadmium, Plant growth, Crop yield, Irrigation, Water supply development, Design criteria.

The 'living filter' program begun in 1963 at Pennsylvania State University is one of the earliest representatives of land application systems. The program is currently being converted from a small, experimental scale to a full scale. The success of the living filter system has been due partly to the physical relationship of the system to the community it serves, the region where it is located, and the natural environment in which it operates. The agricultural valley of the area is underlain with limestone and dolomite placed with geologic joints, faults and forested sandstone mountains. In the center of the valley is a low ridge underlain mostly by sandy dolomites. The valley is drained more by groundwater flow than by surface streams. The proper location for the land application site was determined to be on this low ridge in the center of the valley. Here the deep, sandy residual soils were very permeable and had a hummocky topography. The treated effluent is forced into a pressure pipe leading from the treatment plant four miles up to an elevation of about 200 feet to the fields and forests that had been selected as the land application site. The effluent is distributed under pressure by means of a system of main and lateral pipes and control valves to evenly spaced spray heads. The living filter program has provided an improved environment for growing useful crops. Land moisture has been increased and yields of forage and timber products have helped to reduce the net costs of sewage disposal. In the matter of increased buildup of heavy metals, the increased amount of fast-growing irrigated plants removed cadmium from the soil at very rapid rates. There appeared to be no problem with other metals accumulating either. (Baker-FRC)
W84-00367

BEAR ISLAND DEWATERING 100% TMP SLUDGE, BURNING IN BOILER,
Sirrine (J.E.) Co., Research Triangle Park, NC.
T. R. Hewitt, and R. Ellis.
Pulp and Paper, Vol 57, No 3, p 96-99, March, 1983. 4 Tab.

Descriptors: *Pulp and paper industry, *Sludge thickening, *Dewatering, Incineration, Bear Island Paper Company, Doswell, Virginia, Sludge conditioning, Economic aspects, Vacuum filters, Filters, Centrifugation, Polymers, Hydrasieve, Sludge drying.

The 100% thermomechanical pulp sludge at the Bear Island Paper Company, Doswell, Virginia, is treated with a Hydrasieve and belt filter presses before being mixed with bark and incinerated. This difficult-to-dewater sludge (1.5-2.0% solids) is high in fines content, of which 75-85% passes through a No. 200 sieve. Of the thickening processes tested during development of the sludge treatment program, centrifuge and rotary screen thickener were acceptable, but dissolved air flotation was not. Although centrifuges, diaphragm presses, and V-presses were also effective for dewatering sludge, they were not as economical as the belt filter presses. Operating experience since July 1981 showed that settling and underflow conditions were improved by maintaining a pH of 9.0-9.5 in the primary clarifier feed, adding residual polymer from the press effluent, and slowing down the clarifier rake speed by 60%. Polymer dosage varies with the sludge consistency from 10 to 20 pounds per ton of dewatered sludge. The Hydrasieve produces a 25-33% filter cake which is further dewatered by the belt filter presses. However, the overall cake dryness is limited by serious clogging on the belts. Additional dewatering equipment will be required to produce a filter cake of 35-45%, capable of direct firing of the boiler without added bark. (Cassar-FRC)
W84-00389

THE MOVEMENT OF METALS APPLIED TO SOILS IN SEWAGE EFFLUENT,
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.
For primary bibliographic entry see Field 5B.
W84-00429

RESURRECTION OF DEIGHTON SEWAGE TREATMENT WORKS,
Yorkshire Water Authority (England). Western Div.
For primary bibliographic entry see Field 5D.
W84-00479

SECOND MEMORANDUM OF EVIDENCE TO THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION.
Water Pollution Control, Vol 82, No 1, p 123-125, 1983.

Descriptors: *Water quality standards, *Ocean dumping, *Sludge disposal, Acid rain, Estuaries, Monitoring, Fate of pollutants, *United Kingdom.

On invitation from the Royal Commission on Environmental Pollution, evidence on water quality subjects was gathered. Remedial measures for acid rain must be designed to avoid local pollution of water, for example, proper disposal of spent stack gas scrubbing substances. Although international opinion on disposal of sewage sludge at sea has become more negative, the Institute favors a controlled and well-monitored ocean dumping program. Full implementation of the Control of Pollution Act of 1974 will be a problem for estuaries for which little historical data is available to derive mathematical models of mixing and dispersion. (Cassar-FRC)
W84-00530

AN OVERVIEW OF DIGESTION PROCESSES,
Pretoria Univ. (South Africa). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W84-00552

ENERGY OPTIMIZATION IN SEWAGE AND SLUDGE TREATMENT,
Ruhrverband, Essen (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W84-00553

RECENT DEVELOPMENTS IN SLUDGE CONDITIONING AND DEWATERING,
Omnium de Traitement et Valorisation, Courbevoie (France).
J. C. Cornier, L. Divet, and H. Moreaud.
Water Science and Technology, Vol 15, No 1, p 49-58, 1983. 6 Fig, 3 Tab.

Descriptors: *Sludge conditioning, *Sludge digestion, *Dewatering, Polymers, Polyelectrolytes, Energy, Centrifugation, Anaerobic digestion, Digestion, Incineration.

In France the current objectives in sludge treatment are to minimize chemical and energy costs, facilitate maintenance of the plant, and promote sludge utilization. Replacement of inorganic conditioners such as ferric chloride and lime with polymers has increased filtration rates and simplified maintenance by eliminating lime storage facilities, lime scaling of equipment, and corrosion from ferric chloride. Separate thickening for primary sludges and biologically treated sludges results in sludges of 5-8% solids content vs. the 3-4% seen in some plants. Experiments showed that thermal digestion, incineration of centrifuged sludge, and digestion of the liquors was not only self-supporting with respect to energy but produced a considerable surplus of heat and gas. (Cassar-FRC)
W84-00554

SOUTH AFRICAN PRACTICE IN LAND DISPOSAL OF SLUDGE, INCLUDING LEGISLATION AND HEALTH ASPECTS--AN OVERVIEW,
Department of Health and Welfare, Pretoria (South Africa).
G. Oberholster.
Water Science and Technology, Vol 15, No 1, p 151-155, 1983. 5 Ref.

Descriptors: *Land disposal, *Agriculture, *Sludge disposal, *South Africa, Soil amendments, Water pollution prevention, Legislation, Pathogens, Fate of pollutants, Legal aspects, Regulations, Sludge utilization.

In South Africa sewage and sludge disposal practices vary widely throughout the country. Cities have sophisticated treatment systems or dispose of raw sewage in the sea. Rural areas use pit latrines and other simple systems. Data on sludge production is available only for Cape Province. Here 205 tons of sludge per day are produced, 76.4% from biological filters and activated sludge plants. Of the total sludge production, 64.6% is disposed on land, 89% of this for agriculture. Growers are not enthusiastic about land disposal except in sandy soils which benefit from a soil conditioner. South Africa is concerned with the hazards produced by sludge disposal, especially the pathogen, Ascaris. Legal provisions are available for controlling sludge disposal and preventing water pollution from this source, but to date no regulations have been made. Reasons for this are: (1) the paucity of scientific knowledge, especially on a local basis, and (2) a preference for slowly evolving guidelines, rather than strict statutes. Raw or primary sludge may not be used for agriculture, except as a compost supplement. Secondary sludge is limited to crops not eaten raw by humans and to some parks and sports fields under development. Tertiary sludge application is less restricted; sludge treated with advanced methods may be used anywhere with proper monitoring. (Cassar-FRC)
W84-00555

THE USE OF SEWAGE SLUDGE IN AGRICULTURE,
Water Research Centre, Stevenage (England).
E. G. Coker.
Water Science and Technology, Vol 15, No 1, p 195-208, 1983. 2 Tab, 52 Ref.

Descriptors: *Land disposal, *Sludge disposal, Agriculture, Land reclamation, Reviews, Soil amend-

ments, Soil properties, Water pollution prevention, Nutrients, Fertilizers, Nitrogen, Phosphorus, Organic matter, Sludge utilization, Fate of pollutants, Pathogens, Heavy metals, Metals, Toxicity.

The use of sewage sludge in agriculture is reviewed. Prior to the 1960's there was little enthusiasm for applying sludge to farm soils and little perception of its benefits. The major components in sludge useful in agriculture are organic matter, nitrogen, and phosphorus. The amount and chemical form of nitrogen and phosphorus varies with the type of sludge. Phosphorus content of the sludge can reach 18% as P205 in treatment processes designed to remove phosphorus. Use of sludge in agriculture is limited by the danger of polluting surface and groundwater with N, P, or pathogens. Guidelines for sludge application rates have been developed by countries according to their attitudes toward pollution. Among the trace elements which may be toxic at high accumulations are Zn, Cu, and Ni (phytotoxic) and Cd, Cu, Mo, Se, As, F, Pb, and Cr (harmful to humans and farm animals). Pathogens of concern are Ascaris, Salmonella in cattle yards, and human-beef tapeworm. Contact with pathogens is minimized by lagooning of sludge for 2 years, mesophilic anaerobic digestion of sludge, mechanical cultivation of fields, prevention of grazing on sludged fields for 3 weeks after sludge application, and choosing crops more suitable for growing with sludge (grains, fodder, and grasses). Sludge is also useful in reclaiming derelict land, such as waste tips, pits, and quarries, and in afforestation. (Cassar-FRC)
W84-00556

SEA DISPOSAL OF SLUDGE--THE U. K. EXPERIENCE,
Thames Water Authority, London (England).
H. Fish.
Water Science and Technology, Vol 15, No 1, p 77-87, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Sludge disposal, *Ocean dumping, *United Kingdom, International agreements, Monitoring, Water pollution effects.

Sludge disposal to the sea began on a large scale in the United Kingdom in 1889. Control measures were instituted in the 1960's; full licensing control, in 1974 (Dumping at Sea Act). Each year 10.5 million wet tons (300,000 dry tons) of sludge is disposed of in the sea, 95% by ship and the remainder by pipelines. The outer Thames Estuary receives 45% of the sludge. Present operations of sea disposal of sludge do not seriously affect the marine environment. Nitrogen and phosphorus levels at dump sites are sometimes twice that of unaffected water but are still much less than in the Mersey Estuary, heavily polluted with industrial discharges. Several mechanisms control sea disposal; international conventions (Oslo and London) and supervision by the Minister for Agriculture, Fisheries and Food. Metals concentrations in sewage sludge have dropped dramatically since 1974 as a result of the water authorities' monitoring of industrial wastewaters entering the treatment systems. It is recommended that sea disposal of sewage sludge be continued and expanded in the United Kingdom where economically and environmentally appropriate. (Cassar-FRC)
W84-00557

AGRICULTURAL UTILIZATION OF SEWAGE SLUDGE IN THE U.K.,
Anglian Water Authority, Huntingdon (England).
P. J. Matthews.
Water Science and Technology, Vol 15, No 1, p 135-149, 1983. 5 Tab, 10 Ref.

Descriptors: *Sludge disposal, *Land disposal, *Agriculture, Metals, Heavy metals, Nitrogen, Phosphorus, Nutrients, Fertilizers, Pathogens, Fate of pollutants, Aesthetics, *United Kingdom, Public health, Sludge utilization.

In the United Kingdom about 45% of sewage sludge is applied to agricultural land. For this use several factors are important: chemical quality (especially metals), microbiological quality, esthetic quality, marketability, and reliability of treatment and disposal processes. A table lists the acceptable limits of application for each toxic element. Cadmium is of greatest concern because it is toxic to humans. Zn, Cu, and Ni are phytotoxic in high concentrations. Pathogens of primary concern (salmonellae, intestinal parasites, particularly human-beef tape worm, and potato cyst nematode) have caused problems in only a few cases (not in humans) as a result of poor operational practices. Complaints from the public regarding odors may be minimized by considering wind direction during application, avoiding residential areas, plowing immediately after application, and careful choice of tanker routes. A table lists 11 types of sludge from liquid raw to mesophilic anaerobic digested and the acceptable uses for each. Nutrient contents (N, P, K, Ca, and Mg) of 5 types of sludges are listed on a % dry sludge solids basis. (Cassar-FRC)
W84-00558

SEWAGE SLUDGE HYGIENISATION BY GAMMA RAYS: AN OVERVIEW,
H. Herrnhut.
Water Services, Vol 86, No 1041, p 539, 1982. 1 Fig, 3 Ref.

Descriptors: *Sludge disposal, *Wastewater treatment, *Irradiation, Sludge thickening, Dewatering, Bacteria, Fecal coliforms, Salmonella, Public health, Land disposal.

Anaerobically stabilized sludge is irradiated at a Sulzer gamma irradiation plant in Munich. It is first filled into an above ground metering silo, from where it is passed into the irradiation shaft and then circulated for a fixed time by pumps taking it past the radiation source many times. A dose of 3000 Gray is sufficient to kill disease germs. Together with the activity level of the sources, the dose determines the duration of irradiation, after which the sludge is discharged by pumping. The cobalt-60 sources employed are accommodated in the double wall of a central tube in the irradiation shaft. They are cooled continuously with water in a separate circuit and monitored for leakage. After irradiation the total count of bacilli and Enterococci is reduced by 2 log on the average, and Enterobacteriaceae by 5 log. The counts of fecal bacilli and Salmonellae reduced by gamma irradiation do not increase again on thickening in the dry beds. The effects of irradiated sewage sludge on soils and plants are extremely favorable. Nutrients and trace elements present can be used directly by plants and also influence a number of soil factors. When conventional processes are replaced by irradiation, as a rule the input of primary energy is reduced too. The irradiation plant requires only electrical energy, whereas conventional processes usually consume heat also. (Baker-FRC)
W84-00560

IN-SITU AND ON-SITE BIODEGRADATION OF INDUSTRIAL LANDFILL LEACHATE,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
R. C. Ahlert, and D. S. Kosson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-136787, Price codes: A03 in paper copy, A01 in microfiche. U.S. Dept. of the Interior, OWP. Center for Coastal and Environmental Studies Completion Report, June 1983. 21 p, 9 Fig, 4 Tab, 10 Ref. OWRT A-062-NJ(1), 14-34-0001-1132.

Descriptors: Industrial wastewater, *Leachates, *Biodegradation, Wastewater renovation, *Landfills, Soil bacteria.

Leachate from industrial landfills threatens surface water and groundwater quality and can pose significant management problems. In-situ and on-site treatment processes avoid the economic and technical disadvantages, as well as environmental risks, incurred by transport of this type of hazardous material to alternate treatment facilities. An in-situ/on-site treatment process has been developed utilizing biodegradation by a mixed microbial population, subsequent to lime flocculation pretreatment. Biodegradation is viewed as occurring in the landfill itself or in an adjacent soil system. To investigate the proposed treatment process, pilot-scale field experiments have been designed and carried out. A pilot-scale field installation, consisting of six soil columns, two feet in diameter and five feet deep, have been exposed to leachate application under natural environmental conditions. Experiments were conducted using specimens of sandy loam and clay loam soils. The experiments were designed for complete effluent recovery, allowing material balances. Vacuum was applied at the base of each column, balancing capillary forces and simulating natural drainage and water retention. Variables included hydraulic, organic carbon and nutrient loading rates, soil type and environmental conditions. The field experiment was operated for 169 days in 1982. Influent flow rates averaged about 10 liters/sq. meter/day. Liquid volumes were recovered fully, except for expected minimal losses due to evaporation. Overall organic carbon removal exceeded 90%. Reductions in excess of 95% were readily attainable.
W84-00686

5F. Water Treatment and Quality Alteration

DESORPTION OF COMPOUNDS DURING OPERATION OF GAC ADSORPTION SYSTEMS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
W. E. Thacker, V. L. Snoeyink, and J. C. Crittenden.
Journal of the American Water Works Association, Vol 75, No 3, p 144-149, March, 1983. 8 Fig, 7 Tab, 22 Ref.

Descriptors: *Activated carbon, *Organic compounds, *Desorption, Adsorption, Model studies, Mass transfer, Hydraulic loading, Chlorinated hydrocarbons, Equilibrium, Water treatment.

Desorption of organic compounds from granular activated carbon was studied with a verified mathematical model to evaluate factors caused by reduction in influent concentration or by completion. Compounds chosen for study were chloroform and bromodichloromethane. For desorption resulting from a decline in influent concentration the overall rate of adsorption decreases with increasing carbon particle size and decreasing surface diffusivity, film transfer coefficient, equilibrium capacity, isotherm slope, and bed length. Higher hydraulic loadings produce a slower rate expressed as mass desorbed per bed volumes passed and a faster rate expressed as mass desorbed per time. For desorption resulting from competition, the extent of overshoot decreases with decreasing surface diffusivity, film transfer coefficient, and bed length, and increasing hydraulic loadings and particle size. Basically, improved mass transfer leads to faster or greater desorption. A decline in influent concentration or competition can produce effluent concentrations greater than influent concentrations for a significant period of time, possibly several weeks. A system designated for good adsorption is also likely to desorb efficiently. (Cassar-FRC)
W84-00385

MODELING COPPER CORROSION IN WATER WITH LOW CONDUCTIVITY BY USING ELECTROCHEMICAL TECHNIQUES,
Washington Univ., Seattle. Dept. of Civil Engineering.
R. D. Hilburn.
Journal of the American Water Works Association, Vol 75, No 3, p 149-154, March, 1983. 10 Fig, 2 Tab, 10 Ref.

Descriptors: *Copper, *Corrosion control, *Kinetics, Water treatment, Water distribution, Pipes, Flow velocity, Temperature effects, Seattle, Washington, Tolt River, Aggressive water.

Corrosion rates of copper in synthetic water (containing inorganic anions and cations found in Seattle's Tolt River supply) were measured using electrochemical methods and coupon tests. Models for control of corrosion rate were chemical reaction, diffusion of reactive species through the oxide film, and diffusion of reactive species through the solu-

tion. Experimental temperatures were 5, 15, and 25 degrees C; pH ranged from 6.0 to 8.3. In this water supply solution diffusion was most rate limiting, followed by oxide film transport and kinetics. In general, corrosion rate decreased with an increase in pH and a decrease in temperature. Increases in fluid flow velocity through a copper tube would increase the corrosion rate to a point at which corrosion becomes controlled by the mechanism, diffusion through oxide film. The most effective copper corrosion control technique for this water is reducing the kineticrate, with added protection of increased pH. (Cassar-FRC)
W84-00388

SAFETY AND THE HUMAN FACTOR,
Garland Dept. of Wastewater Treatment, TX.
A. Smith.
Water/Engineering and Management, Vol 129, No 12, p 32-34, 1982.

Descriptors: *Safety, *Water treatment industry, *Occupations, Occupational hazards, Hazards, Accidents.

The water pollution control field is faced not only with enormous technical problems, but also with one of the worst accident rates of any industry. A safety program consists of four main elements: safety training, safety inspections, accident investigations and protective safety equipment. Accidents which are specific to the water treatment field include falls and drowning hazards. Significant hazards are also posed by trickling filters in three ways: the force with which the water causes the filter arm to rotate; the fact that most filter arms are built too close to the bed of media and could drag an operator if he slipped and fell in the path of the rotating filter arm; and the extremely slippery nature of the filter media biomass, which greatly increases the likelihood of an inadvertent fall. Hazards due to confined space entry include such areas as manholes, lift stations, wet wells and anaerobic digesters. Collection and distribution system safety includes dealing with confined space entries, traffic and trenches. Chlorine, a deadly gas, is sometimes used carelessly due to overfamiliarity with it. The same can be said for other hazardous chemicals used in the treatment plants. Harmful exposure to other chemicals which enter the system as pollutants must also be considered. (Baker-FRC)
W84-00486

FRESH WATER FOR THE KEYS,
South Florida Water Management District, West Palm Beach. Dept. of Resource Management.
R. F. York.
Water/Engineering and Management, Vol 129, No 12, p 30-31, 1982.

Descriptors: *Water conveyance, *Water demand, Water distribution, Aqueducts, *Florida, Florida Keys.

The Florida Keys project is undoubtedly one of the largest and most demanding installations of ductile iron pipe tackled so far. The pipeline design called for 453,300 ft or about 87 miles of pipe, mostly overland trenched, but with several subaqueous crossings and 11 bridge crossings. Of this, almost 70 miles consists of ductile iron, and the remaining 17 miles is steel. The new pipeline was designed to be of more than one size. From Florida City to Tavernier a 36 inch pipe was used. From Tavernier to Marathon, 30 in was installed. From Marathon toward Key West, 24 in pipe was used. There is also a 12 in spur from Key Largo to Ocean Reef. The total length of the Florida Keys aqueduct system is about 131 miles, thought to be the longest treated water line in the United States. The cost of the line was $50 million. (Baker-FRC)
W84-00490

RECOMMENDED STANDARDS FOR WATER WORKS.
For primary bibliographic entry see Field 8A.
W84-00501

HYDRAULIC AND GEOLOGICAL PROBLEMS OVERCOME AT BOBCAYGEON'S WATER AND SEWAGE TREATMENT PLANTS,
P. J. McGrenere.
Water and Pollution Control, Vol 121, No 1, p 12-13, January/February, 1983.

Descriptors: Water treatment, Wastewater treatment, Bobcaygeon, *Ontario, Aeration.

A water treatment and wastewater treatment system was designed for Bobcaygeon, Ontario, a resort area with variable population, located on a thin layer of till overlying bedrock. Part of the village is located on three small islands made from fill dredged out of the Trent Canal. The existing diatomaceous earth water treatment plant is used during low demand periods in winter. Two package plants (contact zone, tube settler clarifier and dual media self backwashing filters) go on stream for summer visitors. The wastewater treatment plant consists of two separate extended aeration units. Both are used in summer, one in winter. The hydraulic grit removal channels and outfall are common to both plants. The fissured limestone under the facility was capped with concrete, and urethane insulation was installed to prevent frost heaving. Final costs for the project, serving 5600 persons in the summer, were $11.2 million. (Cassar-FRC)
W84-00515

CLINOPTILOLITE IN DRINKING WATER TREATMENT FOR NH4+ REMOVAL (UTILISATION DE LA CLINOPTILOLITE EN POTABILISATION DES EAUX--ELIMINATION DE L'ION NH4+),
Rennes-1 Univ. (France). Lab. of the Chemistry of Water and the Environment.
M. Gaspard, A. Neveu, and G. Martin.
Water Research, Vol 17, No 3, p 279-288, March, 1983. 12 Fig, 3 Tab, 5 Ref.

Descriptors: *Ion exchange, *Ammonium, *Water treatment, *Clinoptilolite, Hardness, Cations, Zeolite.

Ion exchange was used to remove ammonium ions in drinking water treatment process. Clinoptilolite, a natural cation zeolite, had a small ammonium ion exchange capacity compared with its total capacity of 2.17 meq per g. In a soft water (35-50 mg per liter Ca) the practical ion exchange capacity was 0.06 and 0.108 meq per g for ammonium concentrations of 1 and 2 mg per liter, respectively. The treated volume of water to breakthrough, defined at 0.5 mg per liter ammonium, was > 720 bed volumes. Capacities for hard water treatment were less. Upflow regeneration proved more effective than downflow regeneration in reducing ammonium leakage. Pilot tests showed an ammonium leakage of 0.2 mg per liter and a treated volume to breakthrough (0.5 mg per liter) of 750 bed volumes for a 2 mg per liter ammonium influent. After three regenerations in a second column performance decreased by 25%; ammonium leakage increased but remained less than 0.5 mg per liter. (Cassar-FRC)
W84-00520

PROVING THE POINT FOR DISSOLVED AIR FLOTATION IN POTABLE WATER PLANT.
Water Sciences, Vol 84, No 1009, p 150-151, March, 1980.

Descriptors: *Flotation, *Aeration, *Water treatment facilities, Potable water, Dissolved air flotation, Glendye Treatment Plant, Scotland, Bewl Bridge Water Treatment Works, *England, Flocculation, Filtration.

An article published in Water Services, Vol 84, No 1006, p 19, January, 1980, described the Bewl Bridge water treatment plant as the first of its kind to use dissolved air flotation. The present article describes earlier applications of DAF. Although the Bewl Bridge plant was the first to be designed and built from conception around this process, Water Management Limited was the first company to introduce DAF on a commercial scale. The first DAF plant of this company was installed in 1975 at the Glendye Filter Station near Aberdeen, Scotland. The high color of the raw (peaty) water at Glendye required that alum flocculation be supplemented with dissolved air flotation. About 8 potable water plants are currently in operation. Relocatable package DAF plants are now available. These are quickly installed and may be moved as needed. DAF is also used in wastewater treatment. High throughput is possible, and microprocessor control has been implemented. (Cassar-FRC)
W84-00561

EFFICIENCY OF POINT-OF-USE TREATMENT DEVICES,
Everpure, Inc., Westmont, IL.
P. Regunathan, W. H. Beauman, and E. G. Kreusch.
Journal of the American Water Works Association, Vol 75, No 1, p 42-50, January, 1983. 12 Fig, 10 Tab, 15 Ref.

Descriptors: *Water treatment, *Activated carbon, *Carbon filters, *Membrane filters, *Reverse osmosis, *Performance evaluation, Suspended solids, Coliforms, Organic compounds, Pesticides, Adsorbents, Potable water, Filters, Filter media.

The performance efficiency of two point-of-use water treatment devices was evaluated in a barrage of testes. One device consisted of a granular activated carbon bed and a precoat filter, while the other was made up of a reverse osmosis (RO) unit, a prefilter and two granular carbon adsorption units. The granular-precoat device was successful in removing 80-90% of the chloroform and carbon tetrachloride from spiked samples for at least 3700 liters of treated water, while the RO unit system removed 95-97% of trihalomethanes and chloroform from spiked samples for at least 4900 liters of treated water. Point-of-use treatment devices were also capable of removing large amounts of pesticides from spiked treated water samples, but in the removal of several inorganic contaminants, a steady state was reached within the first hour of operation for RO modules. RO and granular precoat devices were very efficient at removing asbestos fibers, protozoan cysts and volcanic ash from treated water samples. Evidence is presented to show that precoat carbon filters do not consistently yield significantly higher levels of bacteria compared with influent levels. In RO-carbon devices, higher levels of indigenous organisms can be reduced by flushing 3.7-7.5 liters of water through the system. Both the granular-precoat device and the RO-carbon system did not encourage the growth of Escherichia coli, even under quiescent conditions. It was concluded that, if properly used, point-of-use treatment devices could effectively supplement centralized water treatment systems. (Geiger-FRC)
W84-00569

DISCUSSION OF; ROLE OF ADSORPTION IN BIOLOGICAL EXTENDED ACTIVATED CARBON COLUMNS, AND AUTHOR'S RESPONSE,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W84-00570

DISINFECTION, WATER QUALITY CONTROL, AND SAFETY PRACTICES OF THE WATER UTILITY INDUSTRY IN 1978 IN THE UNITED STATES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
R. C. Hoehn, and J. D. Johnson.
Journal of the American Water Works Association, Vol 75, No 1, p 51-56, January, 1983. 17 Tab, 3 Ref.

Descriptors: *Drinking water, *Water quality control, *Disinfection, *Chlorination, *Surveys, *Utilities, *Water treatment, Data collections, Chlorine, Organic compounds, Water quality, Turbidity.

Answers to questionnaires sent to more than 300 water utilities in March of 1978 were examined to gain information of disinfection, water quality control and safety practices before making treatment

modifications to control trihalomethane (THM) levels in drinking water. Results showed that high levels of gaseous chlorine were being used at more than one point by most utilities, but one-third of the respondents indicated that chlorine was only applied in the distribution system. Most respondents reported poor control of chlorine residuals. The majority of utilities surveyed made no attempt to differentiate between free and total chlorine residuals; the most commonly used method of detection was DPD technique. In 25% of the utilities responding, chlorine-contact times were usually less than 12 minutes. Less than half of the 332 utilities responding used the standard plate count for reporting bacteriological quality. Of those that did, very high bacteria levels were reported. In 20% of 123 systems, chlorine demand was over 5 milligrams/liter, and iron and manganese levels were high, while turbidity was generally quite low. Few utilities surveyed practiced dechlorination. (Geiger-FRC)
W84-00572

SURVIVAL OF SOME FAECAL INDICATOR BACTERIA IN DRINKING WATER,
Biological Research Center, Baghdad (Iraq). Dept. of Environmental Pollution.
S. F. Jazrawi, and A. K. Al-Hindawi.
Journal of Environmental Science and Health, Part A, Vol 17, No 6, p 789-796, 1982. 3 Tab, 7 Ref.

Descriptors: *Chlorination, *Bacteria, *Water treatment, Baghdad, *Iraq, Turbidity, Coliforms, Streptococcus, Fate of Pollutants.

The length of time required for complete kill of indicator bacteria, E. coli and Streptococcus fecalis, in Baghdad, Iraq, water at the highest chlorine dose (0.8 mg per liter of chloride of lime) was 2.0 and 0.5 hours, respectively. Since the residual chlorine in city water was 0.1-0.4 mg per liter, the currently used chlorine doses will have to be increased to provide clean and safe water. Raw water samples were high in turbidity (132 NTU). (Cassar-FRC)
W84-00583

INSTRUMENTATION, TELEMETRY AND AUTOMATION: STANDARDS FOR WATER INSTRUMENTATION,
Northumbrian Water Authority, Gosforth (England).
D. G. Hall.
Water Services, Vol 86, No 1042, p 583-584, 586, 1982. 1 Fig.

Descriptors: *Standards, *Measuring instruments, Planning, Water management, British Standards, Regulations, Water quality standards, Design standards, Specifications.

The availability of well proven standards is fundamental to good practice and essential for manufacturers and users alike in the field of measurement. A British Standard applied to instrumentation serves the needs of the user related to the physical phenomenon to be measured, comprises the statement of the needs of the user to the manufacturer to show him the expectation of the user, and should be used by the manufacturer to declare to the purchaser that his instrument has been constructed so that it will produce the data he requires at the level of quality he needs. The procedure to be followed in developing a standard is briefly described. Since the development and publishing of an international standard takes up to five years, those drafting the standards must have at least ten year horizon in view. (Baker-FRC)
W84-00587

5G. Water Quality Control

THE DYNAMICS OF GROWTH, THE EFFECTS OF CHANGING AREA AND NITRATE UPTAKE BY WATERCRESS NASTURTIUM OFFICINALE R. BR. IN A NEW ZEALAND STREAM,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
C. Howard-Williams, J. Davies, and S. Pickmere.
Journal of Applied Ecology, Vol 19, No 2, p 589-601, August, 1982. 6 Fig, 4 Tab, 29 Ref.

Descriptors: *Nitrogen removal, *Nitrates, *Watercress, *Water quality, Streams, Water quality control, Plant growth, Seasonal variations, Nutrients, Nutrient uptake.

The growth of watercress in a stream was related to the seasonal removal of dissolved nitrogen and its incorporation into plant biomass. The maximum relative production rate occurred in mid-summer, being 0.0569 g/g/day. Leaf tissue and root tissue both increased early in the growing season, but in late summer and winter plants had a high proportion of stem, up to 60%. The changing area of the plant population complicated calculations of plant production and the interpretation of production rate/mean monthly quadrat biomass ratios. The same factor also affected the calculation of nutrient uptake. In mid-summer the field measurements of nitrogen uptake by plant showed that 1.140 g N/sq m/day was accumulated. A pattern of nitrate-nitrogen loss from the stream water was demonstrated; this loss could all be accounted for by watercress uptake, which exceeded (to a greater or lesser extent depending on the effect of changing area) the loss from the stream. The nitrogen-rich soils of the cress beds could provide the deficit. Very fast growth rates and a high nitrogen affinity make watercress an ideal plant for stripping nitrate from stream water. However, nitrate uptake is a summer phenomenon only, and rapid decomposition rates of cress suggest that much of the stripped nitrogen will eventually be returned to the water. Denitrification in the Whangamata cress beds does occur, but this apparently accounts for a small portion of the nitrate lost from the stream during summer. (Baker-FRC)
W84-00354

ESTABLISHING STANDARDS TO CONTROL DIRECT AND INDIRECT DISCHARGERS.
Clearwaters, Vol 12, No 3, p 5-8, 1982. 1 Ref.

Descriptors: *Water pollution control, *Standards, Water quality, Water quality control, Water quality standards, Legislation.

In order to achieve the goals of the Clean Water Act, certain effluent limitations must be based on water quality standards. Only through regulating dischargers on the basis of the needs of the receiving water can a reasonable, cost effective approach to water pollution control be implemented. Some of the strengths and weaknesses of the existing standard-setting process under the present Clean Water Act are described. It is suggested that Congress should give priority to establishing a single system for controlling direct dischargers and a second system, if needed, for indirect dischargers. Three possible systems considered include the use of water quality standards, a technology-based categorical standard, and pollutant-specific guidance systems. Since it would take at least 10 years to fully implement a water quality-based system, the NYWPCA believes that, in the interim, the Act should mandate that S/NPDES permits be issued with effluent limitations that are based on PS criteria. Not only will such an interim approach enable maximum utilization of existing data while assuring an almost immediate improvement in the quality of treated wastewater discharged nationwide, but it will also provide a common ground for individual permit negotiation. (Baker-FRC)
W84-00357

LONG-TERM STUDY OF VIRUS CONTAMINATION OF SURFACE WATER IN THE GERMAN DEMOCRATIC REPUBLIC,
Forschungsinstitut fuer Mikrobiologie und Hygiene, Bad Elster (German D.R.).
For primary bibliographic entry see Field 5A.
W84-00365

TOXICOLOGICAL FUNDAMENTALS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
G. D. Boardman, and J. H. Sherrard.
Water/Engineering and Management, Vol 130, No 3, p 34-36, March, 1983. 8 Ref.

Descriptors: *Toxicity, Water pollution effects, Hazards, Carcinogens, Absorption, Dosage.

Basic facts about toxicology for water and wastewater personnel include several definitions. Toxicity is the capacity of an agent to cause harm; hazard is the probability that injury will occur. Exposures are acute (hours), subchronic (up to 3 months), and chronic (3 months or more). Local effects occur at the site of contact; systemic effects, at a site other than the point of contact. Dosage is the most important factor governing the ability of an agent to cause harm. Dosage appears as the lethal dose to 50% of the test population (LD50), maximum allowable concentration (MAC), threshold limit value (TLV), or maximum contaminant level (MCL). Other factors in toxicologic experiments include species, sex, age, activity, history, and physiological condition of subject; anatomical, behavioral and physiological differences; dosage, route of administration (dermal, oral, respiratory, etc.); temperature, pH, humidity, etc.; statistical significance of data; interaction with other agents; and storage, transformation, and excretion. The partition coefficient of a compound has been related to some toxicological properties. Cancer-causing agents are sometimes classified into genotoxic (react covalently with DNA, such as vinyl chloride) or epigenetic (solid-state carcinogens, such as asbestos, hormones, and immunosuppressors). (Cassar-FRC)
W84-00481

SCHENECTADY COUNTY AQUIFER PRESERVATION STRATEGY PROGRAM.
Schenectady County Planning Dept., NY.
Final Report, August 1980. 32 p, 14 Fig, 1 Append.

Descriptors: *Aquifer management, *Aquifer characteristics, *Groundwater storage, *Water resources development, Flood plain management, Planning, Water management, Regional development, Rivers, Water supply systems, Water supply, Water consumption, *New York.

Five Schenectady County municipalities and more than 80% of its residents rely entirely on the subsurface gravel deposits of the Mohawk Valley for their public water supply. This aquifer area has been increasingly prone to development due to the construction of an interstate highway and the pressures of suburban expansion. A report completed in 1978 recommended measures to preserve nine critical aquifer areas. A subsequent report in 1980 described the existing and projected best uses for each parcel and the costs to either purchase or restrict the easements to each. The current aquifer preservation strategy suggests preserving those areas that are the most important to existing and future public water supplies. This report lists a wide range of actions that must be instituted to protect the aquifer from contamination originating outside of the critical areas. The implementation plan recommendations include creation of a county water council, upgrading the classification of the Mohawk River, flood plain management, sole source designation for the aquifer, collection of letters of record for land parcels, and spill cleanup coordination. (Garrison-Omniplan)
W84-00498

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CONFLICT AND RISK IN THE OPTIMUM MIX OF ADJUSTMENTS TO FLOODS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
T. L. Morin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125145, Price codes: A04 in paper copy, A01 in microfiche. Technical Report No 152, September 1983. 53 p, 4 Fig, 156 Ref. OWRT-B-126-IND(1), 14-34-0001-1224.

Descriptors: *Flood control, *Optimization, Flood damage, Flood plain, *Nonstructural alternatives,

*Decision making, Preference order dynamic programming, Multi-objective planning, Vector optimization.

Water resources agencies are operating and planning in an environment which is complicated by multiple, oftentimes conflicting objectives, uncertainties and risks. The situation is especially critical in flood control because of the magnitude of the flood damages, the number of conflicting objectives and impacted groups, and the inherent meteorological uncertainties. Floods are the most widespread geophysical hazard in the United States and they account for greater average annual property losses than any other single geophysical hazard. This realization among others has led to an increasing awareness and interest in the role of nonstructural measures such as floodplain zoning, land use allocation, insurance, and warning as an important and integral part of any overall flood damage mitigation program. However, determining 'optimal mixes of adjustments to floods is very difficult because of the number of conflicting water resources objectives, the degree of interdependence between the structural and nonstructural measures, the multitude of feasible combinations of structural and nonstructural measures which must be considered over time and space. This report discusses multiple objective optimization and decision making in the context of flood control and develops a dynamic approach which involves the amalgamation of the often disparate fields of utility theory and vector optimization into an integrated methodology based on the notions of 'preference order dynamic programming,' a recursive algorithm not requiring the existence of a real-valued return function. This report also discusses practical issues involved with the use of the method as well as other implementation and computational details.
W84-00447

DISCUSSION: 'OPTIMAL RESERVOIR MANAGEMENT AND CROP PLANNING UNDER DETERMINISTIC AND STOCHASTIC INFLOWS,' BY C. C. MAJI AND E. O. HEADY,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W84-00526

A MANAGEMENT MODEL FOR DETERMINING ACCEPTABLE TYPES AND LEVELS OF RECREATION AT PUBLIC DRINKING WATER RESERVOIRS,
Massachusetts Univ., Amherst. Water Resources Research Center.
L. R. Klar, Jr., M. Gross, P. J. Murphy, E. M. Mahoney, and M. S. Switzenbaum.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132448, Price codes: A12 in paper copy, A01 in microfiche. Water Resources Research Center Publication No 144, Massachusetts Univ., Amherst, June 1983. 243 p, 31 Fig, 48 Tab, 152 Ref, 16 Append. OWRT B-078-MASS(1), 14-34-0001-1233.

Descriptors: *Cost-benefit analysis, *Domestic water, Model studies, Project planning, *Recreation, Recreation demand, Recreation facilities, Reservoirs, *Reservoir operation, Use rates, *Water policy, Quabbin Reservoir, Beaches, Camping, Competing uses, Cost repayment, Cost sharing, Fishing, Fish management, Forest management, Hunting, Multiple-purpose reservoirs, Recreation wastes, Reservoir fisheries, Social aspects, Waste disposal, Water sports, Water supply, Wildlife conservation, Wildlife management, Massachusetts.

A management model was developed for determining optimal mixes of recreation activities at public drinking water reservoirs. Quabbin Reservoir, located in central Massachusetts, served as a case study for the model. An interdisciplinary research team was formed to study (1) the impact of selected recreation activities on water quality, (2) public demand and willingness to pay for selected recreation activities at Quabbin, (3) the carrying capacity potential of the reservoir and (4) the cost-benefits associated with increases in recreation at Quabbin. All study variables were integrated into a quadratic programming model producing optimal recreation activity mixes as outputs. The optimal mix included hiking, fishing, picnicking (presently permitted activities), canoeing, sailing and swimming (presently prohibited activities). These activities were found to be cost-effective (assuming the use of reasonable entrance fees) and not deleterious to water quality. Nutrients, particularly from wastewater, should not be permitted to enter the water since current phosphorous levels may be at a critical point. This can be assured with proper precautions and effective management techniques. The model was sensitive to management objectives; recommendations were limited to activities that would not lower the existing high quality of Quabbin water.
W84-00592

6B. Evaluation Process

REAL TIME ADAPTIVE CLOSED LOOP CONTROL OF RESERVOIRS WITH THE HIGH ASWAN DAM AS A CASE STUDY,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
R. L. Bras, R. Buchanan, and K. C. Curry.
Water Resources Research, Vol 19, No 1, p 33-52, February, 1983. 16 Fig, 7 Tab, 13 Ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Flood control, Aswan Dam, Egypt, Model studies, Stochastic hydrology, Irrigation, Toshka Spillway, Multipurpose reservoirs.

An algorithm incorporating real time streamflow forecasts into reservoir operation was used to predict inflows into the High Aswan Dam. This adaptive control technique can handle situations where streamflow transition probabilities and system objectives are continuously updated and changing over finite transient periods before achieving steady state conditions. A comparison of results obtained with a steady state stochastic dynamic programming approach was made with the heuristic operational policy which is used at the dam. Improvements in system performance depended on the system configuration. With operation of the Toshka spillway, the new scheme showed little improvement relative to the steady state scheme. For no Toshka spillway and annual abstractions from the Sudan of 16.5 billion cu m, considerable improvements were demonstrated using the new scheme. The most significant benefit is likely to be improved flood control. Streamflow forecasts for the beginning of a drought period are particularly important because they may allow the release of more water than needed to meet the irrigation requirements, thereby preparing storage space for high inflows which may follow. (Cassar-FRC)
W84-00391

DISCUSSION 'MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,' BY W. B. LORD,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6D.
W84-00414

EVALUATION OF ECONOMIC RETURNS FROM INVESTMENT IN DOMESTIC RURAL WATER DEVELOPMENT,
South Dakota State Univ., Brookings. Dept. of Economics.
R. Hoffman, A. Lundeen, and R. Green.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120831. Price codes: A05 in paper copy, A01 in microfiche. Water Resources Institute Completion Report, July 1983. 59 p, 20 Tab, 13 Ref, 1 Append. OWRT A-080-SDAK(1), 14-34-0001-2144.

Descriptors: *Domestic water, *Stock water, Water resources development, *Economic impacts, *Rural water systems, Livestock productivity, Agricultural productivity, Domestic rural water development, *South Dakota.

The impacts of a rural water system on livestock productivity and production in two counties in South Dakota were investigated. Both members and nonmembers of rural water systems were surveyed to learn if there were differences between the two groups in number of livestock on hand, stability in numbers of livestock, effects of drought on livestock numbers, and changes in productivity because of an assured supply of quality water. Reported incidences of livestock producers being forced to sell or board out livestock during drought were few and about equal for nonmembers and members. Rural water system members held a higher absolute number of cattle in Tripp County and all livestock in Moody County. However, the differences were significant only for milk cows and beef cows in Moody County for one year in the surveyed period. Tripp county nonmembers had a significantly higher number of breeding hogs on hand in all four surveyed years. No statistically significant differences were found between the groups in changes in number of livestock. About one-quarter of the rural water system members reported substantial increases in average daily gain due to the availability of good quality water. Approximately 10% reported decreased newborn mortality rates or decreased medicinal costs.
W84-00433

THE RED RIVER GORGE: THE EXISTENCE OF 'RECREATIONAL NICHES' AND THEIR MANAGEMENT IMPLICATIONS,
Kentucky Water Resources Research Inst., Lexington.
S. E. Alexander, B. R. Dewalt, and E. Scott.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120914, Price codes: A11 in paper copy, A01 in microfiche. Research Report No 145, September 1983. 232 p, 4 Fig, 49 Tab, 54 Ref, 2 Append. OWRT A-079-KY(2), 14-34-0001-9019(FY 79), 14-34-0001-0119(FY 80), 14-34-0001-1119(FY 81).

Descriptors: *Recreation facilities, *Recreation demand, *Recreation, Wild rivers, Tourism, *Red River, Kentucky, River recreation management, Social carrying capacity, Recreational niches, Visitor preferences.

This report examines the recreationists' socio-demographic characteristics, the recreational activities engaged in, their density tolerance levels, and their preferences for development of the Red River Gorge, Kentucky. Eleven 'recreational niches' (defined as a specific location within a recreation area occupied by visitors pursuing different kinds of leisure-time activities) were identified. Preservation of the niches are recommended as a means for maintaining both the ecological and social diversity of the Red River Gorge. Substantial increases in visitation has resulted in not only severe environmental degradation to the area but extensive overcrowding as well. These trends are presently overtaxing the management capabilities of the area. The pressing issue is how to effectively manage this area to preserve both its ecological and social attractiveness.
W84-00441

THE DREDGING DILEMMA: SYSTEM PROBLEMS AND MANAGEMENT SOLUTIONS.
New England River Basins Commission, Boston, MA.
Report, September 1981. 26 p, 14 Fig.

Descriptors: *Dredging, *Planning, *Harbors, *Coastal engineering, *Multiobjective planning, *Management planning, *Long-term planning, Waterfront facilities, Interagency cooperation, Evaluation, Economic aspects, Comprehensive planning, Disposal sheds.

While efficient harbor facilities contribute to the economic base of coastal regions, management of dredging has become a controversial public issue. In the private and public sectors there is currently no process for arraying and assessing future demands for dredging. This study examines dredging as a set of interrelated functions directed to a specific end. Three basic flaws, endemic to the

dredging system as a whole, are identified: (1) unclear objectives; (2) isolated reviews of dredging proposals; and (3) limited evaluations. A proposed solution is a management planning process that emphasizes interagency cooperation and the establishment of agreed-upon objectives to guide dredging decisions, and to provide a basis for evaluating the results of dredging initiatives. In addition to defining objectives and setting priorities, dredging management could be improved by identifying disposal sheds, developing sediment characterization criteria, designating public disposal sites, establishing disposal site management methods, and evaluating and updating the management program on a regular basis. Specifically regarding the dredging of New England and Long Island Sound waters, there are eleven feasible disposal sheds to which dredging management could be applied. (Garrison-Omniplan)
W84-00502

PROJECTED DEMANDS AND SUPPLIES OF WATER UNDER ALTERNATIVE ENERGY AND AGRICULTURAL DEVELOPMENT SCENARIOS IN THE GREEN RIVER DRAINAGE OF WYOMING,
Wyoming Univ., Laramie. Coll. of Agriculture.
D. R. Franklin, J. J. Jacobs, and P. J. Farris.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132471, Price codes: A04 in paper copy, A01 in microfiche. Water Research Center Completion Report, August 1983. 53 p, 1 Fig, 9 Tab, 48 Ref, 1 Append. OWRT A-039-WYO(1), 14-34-0001-2154.

Descriptors: Water conservation, Water allocation, Saline water, Water resources development, *Water demand, *Water supply, Irrigation water, Industrial water, *Economic impact, Agricultural development, Energy development, *Wyoming, *Green River Basin.

Five alternative salinity management policy and agricultural growth scenarios were analyzed for the Green River drainage in Wyoming. A linear program model was developed that evaluates the economic impacts of water development with salinity management policies. The results indicate that energy development can take place without imposing undue salinity damage cost downstream if no additional development occurs downstream from Wyoming. However, large scale agricultural development could increase salinity damage cost in the form of reduced energy production and/or monetary cost to the State.
W84-00634

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

FACILITIES NEEDS SURVEY OF COMMUNITY PUBLIC WATER SYSTEMS,
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
P. A. Chiefari.
Report, April 1983. 64 p, 4 Fig, 33 Tab, 3 Append.

Descriptors: *Project planning, *Distribution patterns, *Water quantity, *Water supply, Aqueducts, Urban planning, Operating costs, Projections, Operating policies, Water rates, Water distribution, *Capital costs.

Many water systems in New York State suffer from capital and physical deficiencies. To correct these problems, it is necessary to determine their extent and estimate the cost of correction. A survey using personal interviews and mailed questionaires was conducted by the New York Department of Health. In New York State, 1,420 community public water supplies provide 16.5 million people with 3.7 billion gallons of water a day. The total statewide funding need was found to be $6.8 billion, with $4.2 billion required by New York City. The highest priority in preferred spending was given to distribution system improvements, with treatment, storage, and source a nearly equal second. Additional areas examined in interviews with water system personnel included water rates, metering and operations and maintenance. In terms of capital cost to remedy these needs, problems arise because the component costs are large and such costs weigh heavily against smaller systems whose per user annual assessments are high. Additionally, certain projects are so expensive that even the very largest systems would have difficulty in building them without federal assistance. A proposed water project for New York City, for example, is estimated to cost $3.4 billion. (Garrison-Omniplan)
W84-00496

6D. Water Demand

SMALL HYDRO MAY HELP CZECHOSLOVAKIA'S NEEDS.
For primary bibliographic entry see Field 4A.
W84-00410

HYDROPOWER PROSPECTS FOR SPAIN,
For primary bibliographic entry see Field 4A.
W84-00411

DISCUSSION 'MUNICIPAL WATER SUPPLY RESTRICTIONS AS URBAN GROWTH CONSTRAINTS,' BY W. B. LORD,
Economic Research Service, Washington, DC. Natural Resource Economics Div.
R. L. Anderson.
Water Resources Bulletin, Vol 19, No 1, p 131-133, 1983.

Descriptors: *Water supply development, *Water demand, Denver, Colorado, Pricing, Water use, Municipal water.

In the original paper (Water Resources Bulletin, Vol 18, No. 2, p 271-277, 1982) the idea was presented that limiting water supply does not inhibit urban growth. Various studies were cited to show that growth occurs in areas where water supplies are limited. In an examination of residential use of water, the original author states that substantial savings in water use by householders. The argument is stated that industrial and commercial growth can be accommodated within existing municipal supplies if residential demands can be reduced. The discussant maintains that the suggestion to homeowners that lawns can survive on 70% of the water they are capable of taking up is illusory; that to put watering or waste of water on lawn watering on a gallon-per-day basis is clearly inaccurate and misleading, as residents in Colorado's Front Range cities water their lawns only rarely at present anyway; and that raising prices for water could turn out to be a lawn tax, with far reaching effects on the older, fixed-income area residents rather than on new members of the community. The discussant suggests that the Denver Water Board pursue its historic course of expanding the water supply. While this course has been criticized by certain environmental groups, the disrupting effects of this course are no worse and perhaps less burdensome than depriving urban areas of adequate water. (Baker-FRC)
W84-00414

DISCUSSION 'CONFLICT BETWEEN ESTABLISHMENT OF INSTREAM FLOWS AND OTHER WATER USES ON WESTERN STREAMS,' BY RAMOND L. ANDERSON,
Southern Methodist Univ., Dallas, TX. Dept. of Civil and Mechanical Engineering.
M. A. Collins.
Water Resources Bulletin, Vol 19, No 1, p 137-138, 1983. 2 Ref.

Descriptors: *Water resources development, *Legal aspects, *Water rights, Doctrines, Water demand, Recreational use.

The author of this discussion enlarges upon the theme of the main paper (Water Resources Bulletin, Vol. 18, No. 1, p 61-65, 1982) dealing with the problem of the attack on established appropriate rights and the appropriate rights doctrine itself by advocates of instream water use. Recent studies in Texas are cited to demonstrate the enhancement of natural conditions through appropriate water management practices. Particular mention is made of the Possum Kingdom Reservoir constructed on the Brazos River for the stated purposes of preservation and enhancement of fish and wildlife and recreation in generally recognized scenic river reaches below the reservoir. This dam, built in the 1930s, has enhanced downstream conditions significantly over the years. While concern for recreational interests, in itself, is certainly acceptable, inadequate consideration of the impact of recreational objectives on other water uses, particularly established, existing uses, is another issue. There is great diversity of problems arising as different groups compete for the limited water resources in the more arid regions of the United States. The conflict between legally recognized appropriate rights and the rights sought to be imposed by fiat will likely become more intense in the future. (Baker-FRC)
W84-00415

REPORT ON GROUND WATER DEPENDENCE IN NEW YORK STATE.
New York State Dept. of Health, Albany. Bureau of Public Water Supply Protection.
For primary bibliographic entry see Field 2F.
W84-00499

DEVELOPING AND MONITORING MUNICIPAL GROUNDWATER SUPPLIES IN FLORIDA,
West Coast Regional Water Supply Authority, Clearwater, FL.
G. Heath.
Journal of the American Water Works Association, Vol 75, No 2, p 64-67, February, 1983. 7 Fig, 1 Tab.

Descriptors: *Water supply, *Monitoring, *Wells, *Florida, Water demand, Water supply development, Precipitation, Model studies, Geohydrology, Crossbar Ranch Project, Drawdown, Water level, Wetlands, Environmental effects, Seasonal variation, Planning, Groundwater management.

The West Coast (Florida) Regional Water Supply Authority, formed in 1974, relies on extensive data to provide water for the rapidly growing and seasonally variable population of the St. Petersburg-Tampa area. Precipitation (and the groundwater resource's response to it) varies widely, both annually and seasonally. When new well fields are planned, the Authority must consider the available hydrogeological information, water demand, effects on groundwater levels of the proposed withdrawal rates, and effects on the ecosystems. The planning procedure is illustrated in the development of the Crossbar Ranch well field. This involved hydrogeologic tests and computer modeling of the effects of different well locations on groundwater level. Monitoring programs concern levels in the 1500 private wells and 105 wetlands and lakes within 2 miles of the well field, historic lake trends, sinkhole activity, runoff and streamflow water budgets, and the aquatic and terrestrial habitats. Of the $16.3 million spent for the Crossbar project, 12.5% was for investigations and management system instrumentation. (Cassar-FRC)
W84-00573

HYDROLOGY OF THE FLORIDIAN AQUIFER IN NORTHWEST VOLUSIA COUNTY, FLORIDA,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00601

PROJECTED DEMANDS AND SUPPLIES OF WATER UNDER ALTERNATIVE ENERGY AND AGRICULTURAL DEVELOPMENT SCENARIOS IN THE GREEN RIVER DRAINAGE OF WYOMING,
Wyoming Univ., Laramie. Coll. of Agriculture.
For primary bibliographic entry see Field 6B.
W84-00634

GEOHYDROLOGY AND EFFECTS OF WATER USE IN THE BLACK MESA AREA, NAVAJO AND HOPI INDIAN RESERVATIONS, ARIZONA,
Geological Survey, Tucson, AZ. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00642

6E. Water Law and Institutions

ESTABLISHING STANDARDS TO CONTROL DIRECT AND INDIRECT DISCHARGERS.
For primary bibliographic entry see Field 5G.
W84-00357

SECTION 10 OF THE RIVERS AND HARBORS ACT AND WESTERN WATER ALLOCATIONS - ARE THE WESTERN STATES UP A CREEK WITHOUT A PERMIT,
Boston Coll., Chestnut Hill, MA.
M. G. Proctor.
Boston College Environmental Affairs Law Review, Vol 10, No 1, p 111-182, 1982. 478 Ref.

Descriptors: *Legal aspects, *Water rights, United States, California, Arid zone, Arid climates, Federal jurisdiction, State jurisdiction.

A recognized need for reform and the increasing federal need for water may induce the federal government to take on a greater role in western water law in the future. This article analyzes the extent to which the Rivers and Harbors Act can and should be used by the federal government to expand its role in western water allocations. The history and development of western water law and the traditional role of the federal government in western waters is reviewed. The growing conflict over control of western waters and the possible motivation for an increased federal role is discussed. This discussion focuses on the potential applicability of section 10 of the Act to state water allocations. Section 10 bars any unauthorized obstructions to the navigable capacity of any waters of the United States and makes it unlawful to alter or modify any navigable water without the approval of the US Army Corps of Engineers. The territorial and subject matter jurisdiction of the Act and the permit process are detailed. A close examination is offered of California vs Sierra Club, which discusses specific issues left unresolved by the Supreme Court in that it refused to allow the plaintiffs the right to bring suit under the Rivers and Harbors Act. The article concludes with an examination of the extent to which the Rivers and Harbors Act can and should be used in the context of western water allocation. (Baker-FRC)
W84-00368

GROUNDWATER LITIGATION,
Cook Coll., New Brunswick, NJ.
W. Goldfarb.
Water Resources Bulletin, Vol 18, No 5, p 899-900, 1982.

Descriptors: *Legal aspects, *Groundwater management, Supreme Court, Arizona, Nebraska, Water demand, Water use, Exportation, Aquifers, Water law.

The US Supreme Court recently took action on two cases involving the regulating of transportation of groundwater by the states involved. Sprohase v. Nebraska was the more important, dealing with the constitutionality of a groundwater 'antiexportation' statute. Some antiexportation statutes prohibit any exportation of water. Others allow it if the recipient state has legislated reciprocal rights. Nebraska enacted a statute of the latter type, and the state Supreme Court upheld it, based on the view that groundwater is not an article of commerce. The US Supreme Court reversed this view, stating that groundwater overdraft is a national problem and Congress has the power to deal with it on that scale. The second case, Town of Chino Valley v. City of Prescott, raises questions about the ownership of groundwater. The City owns 164 acres of land in the Valley. In 1948 the City drilled wells on some of its Valley property and began transporting groundwater through a 17 mile pipeline to its municipal customers. The Town of Chino Valley was incorporated in 1972 and began drawing groundwater from the same aquifer. The Town claimed the City was taking private property (groundwater) without just compensation. The common law doctrine of riparian rights in Arizona has been replaced by the appropriation doctrine except as regards percolating groundwater. Here the doctrine of reasonable use still applies. The state Supreme Court, and later the US Supreme Court upheld the decision, claiming that the overlying owner does not possess absolute ownership of groundwater but merely a right to the 'usufruct' (use) of the water, subject to state regulation. (Baker-FRC)
W84-00369

REPLY TO DISCUSSION 'POLICY PROBLEMS ASSOCIATED WITH WATERBORNE ASBESTOS', BY MICHAEL EDSON AND W. A. THOMPSON,
Iowa Univ., Iowa City. Dept. of Urban and Regional Planning.
M. F. Sheehan.
Water Resources Bulletin, Vol 19, No 1, p 127-130, 1983. 3 Fig.

Descriptors: *Asbestos, *Legal aspects, *Water pollution sources, Industrial wastes, Industrial discharges.

In this reply the author of the original paper (Water Resources Bulletin, Vol. 17, No. 2, p 275-279, 1981) deals with major points brought out in the discussion paper (Water Resources Bulletin, Vol. 19, No. 1, p 123-126, 1983). The original paper dealt with a temporary stay in discharges from the Reserve Mining Company into the environment, both air and water, of asbestos fibers. The discussion argues that the assertion of the original author that the temporary stay of the Appeals Court was based on the fact that the fiber levels were not occupational levels, that the low levels present could not be measured and therefore did not constitute a health risk, and that it was not known what level of exposure was actually unsafe, is incorrect. The original author replies that the decision clearly stated that the levels of contamination were not equivalent to the contaminated air found in an asbestos factory and the fibers ingested from the Duluth drinking water were not equatable to an occupational exposure level. That the levels of exposure were so low as to be unmeasureable as a health risk is stated in the original court's decision and the argument that this decision could not have been based on these facts but instead had to meet the four criteria set out in the rules for civil and apellate procedure is seen by the original author as a confusion of facts with procedural rules. Facts and procedures are not mutually exclusive in the law. Decisions of this sort must both have a factual basis and meet the rules of procedural due process. (Baker-FRC)
W84-00419

DISCUSSION: 'POLICY PROBLEMS ASSOCIATED WITH WATERBORNE ASBESTOS' BY M. SHEEHAN,
Arizona Univ., Tucson. Dept. of Philosophy.
M. Edson, and W. A. Thompson.
Water Resources Bulletin, Vol 19, No 1, p 123-126, 1983. 6 Ref.

Descriptors: *Water pollution sources, *Legal aspects, Liability, Torts, Asbestos, Policy, Public policy, Rights.

The discussants review and assess a presentation in Water Resources Bulletin, Vol 17, No 2, p 275-279, 1981 on the litigation arising out of the discharge of asbestos-like fibers into Lake Superior by the Reserve Mining Company. The most important aspect of the suit brought against Reserve was that public health and welfare were endangered through this discharging of asbestos-like fibers. The author of the original paper charges that the district court issued an injunction against Reserve's continued discharge purportedly on the basis of Section 504 of the Federal Water Pollution Control Act which permits injunctive relief when the public is faced with an imminent health hazard. However, in truth, the injunction was issued on the basis of the five complaints brought against the company and no determination that a hazard was imminent was made. A stay of the injunction was issued by a federal appeals court, but this was only a temporary stay, pending Reserve's appeal of the case on merits. The confusion of factual and normative issues is a dangerous flaw in argumentation. The charge of the original paper that by not regulating potentially harardous substances the government is contributing to economic inefficiency in the neoclassical sense is addressed by the discussants in stating that determinations of tort liability are not generally based on economic efficiency, but rather on considerations of justice and fairness with respect to compensation for harms incurred. The relevant claim would have been that not regulating the discharge of potentially hazardous substances constitutes a violation of certain principles of equity. (Baker-FRC)
W84-00420

WATER RESOURCES MANAGEMENT IN A FEDERAL SYSTEM: A COMPARATIVE ANALYSIS,
North Carolina State Univ. at Raleigh. Dept. of Political Science and Public Administration.
T. D. Edgmon.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120864, Price codes: A10 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 203, September 1983. 209 p, 43 Tab, 2 Fig, 87 Ref, 1 Append. OWRT B-135-NC(1), 14-34-0001-1254.

Descriptors: *Water management, *Decision making, *Institutional constraints, *Governmental interrelations, *Water policy, Institutions, Local governments, State jurisdiction, Water Resources development, Water supply, Political constraints, Political aspects, Policy making, Planning, Regional planning, Water districts.

The objectives of this study were to review existing information on the organization of state, regional, and local water supply systems, determine the existing pattern of state water management institutions, analyze the evolution of substate water supply organizations in the state of Florida, determine the existing pattern of water resources decision making and intergovernmental relations in North Carolina, and evaluate a set of institutional and organizational alternatives suitable for consideration by policy makers in North Carolina. The study identifies four major types of state water resources management organization: unified, federalist, home rule, and fragmented. A survey discovered that state regulation of consumptive water use is becoming universal, even in the absence of a federal policy and program to provide incentives and sanctions. Most states have implemented their water resource regulatory programs on a decentralized basis, relying on either established local water organization, creating field offices with local policy boards, or developing basin control areas. Data from two surveys was analyzed to portray the structure of municipal organization in water supply, local official perceptions of water supply issues, the structure and process of intergovernmental relations, and an evaluation of local official preferences for areawide strategies of water supply allocation. Local officials generally do not rank water supply problems as serious ones, and prefer that the state continue to play a facilitative role in water areawide approach, and consider county government as a viable institution for water allocation among competing urban interests.
W84-00436

IMPEDIMENTS TO EFFECTIVE INTERACTIONS BETWEEN MULTIPURPOSE WATER DISTRICTS AND OTHER GOVERNMENTAL INSTITUTIONS IN URBANIZING AREAS,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 6F.
W84-00448

GROUNDWATER USE MANAGEMENT IN THE NORTHEASTERN STATES--LEGAL AND INSTITUTIONAL ISSUES.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132463, Price codes: A15 in paper copy, A01 in microfiche. Proceedings, Conference June 2-4, 1981, Pawling, NY. Center for Environmental Research, Cornell Univ., Ithaca, NY 303 p. Raymond L. S., ed. OWRT C-00176-T(No 0518)(8).

Descriptors: Legal aspects, *Groundwater, Model studies, *Contamination, Conservation, Permits, Data collection, Aquifers, Public trust doctrine, Costs, Priorities, Conjunctive use, Land Use, Zoning, *Groundwater pollution, *Water rights, *Water allocation, Policy making, Water shortage, Water use, Public participation, Aquifer systems.

Public authority to act (legal issues), the technical knowledge base for groundwater management, groundwater allocation, the interface between groundwater quality and quantity management, local government responses to groundwater shortages, and groundwater quantity as a managment issue in the Northeast. The doctrines of reasonable use and prior appropriation and their significance for the Northeast. Traditional responses to groundwater contamination problems in the Northeast. Existing common and statutory groundwater law in the Northeast in terms of their relevance to current problems. The state of groundwater knowledge in relation to public policy needs. Groundwater withdrawals in the Northeast in the context of well-drilling regulations, allocation permits, local land use controls, conservation programs, and public vs. private ownership. Case histories of local government response to groundwater shortages in Stoughton, Massachusetts; Chester County, Pennsylvania; and Long Island, New York. Local home rule approaches are contrasted to state level approaches to groundwater management.
W84-00594

6F. Nonstructural Alternatives

CONFLICT AND RISK IN THE OPTIMUM MIX OF ADJUSTMENTS TO FLOODS,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
For primary bibliographic entry see Field 6A.
W84-00447

IMPEDIMENTS TO EFFECTIVE INTERACTIONS BETWEEN MULTIPURPOSE WATER DISTRICTS AND OTHER GOVERNMENTAL INSTITUTIONS IN URBANIZING AREAS,
Utah Water Research Lab., Logan.
J. M. Bagley, F. W. Haws, W. B. Anderson, D. H. Hoggan, and L. Kapaloski.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-125152, Price codes: A08 in paper copy, A01 in microfiche. Completion Report, July 1983. 165 p, 6 Tab, 6 Ref, 1 Append. OWRT B-170-UTAH(1), 14-34-0001-9136.

Descriptors: Water supply, *Institutional constraints, Legal aspects, *Water districts, Political constraints, State jurisdiction, Feasibility studies, Financing, Urban planning, Community development, *Utility extension, Utilities, Potential water supply, *Urban areas, Water management.

Scattered rural towns are largely served by individual water systems. Urbanization fills the areas between older communities and requires system expansions that encourage the smaller systems to combine and search for larger, higher quality, and often more distant and costly supplies. The western states have established a variety of special water districts to serve growing metropolitan areas. Over the years, these districts have had a variety of experiences, both successes and failures, useful in guiding organizational arrangements for supplying water during periods of urban expansion. The large public water districts in Utah, Arizona, Colorado, Nebraska, Oregon, and South Dakota provided the experience data for this study. Applicable statutes were reviewed, and structured interviews were conducted with district officials. The special districts serving a number of communities have often responded to visions of pending water shortage by committing themselves, legally and financially, to major water projects. These obligations constrain the district's flexibility to adjust its water supply system to changes in demand and supply situations. The political commitment required for their formation also restricts thoughtful examination of system management alternatives because of fears that new options will erode public support to continuing repayment. State government needs to exercise its oversight responsibility in promoting harmonious coordination between districts and the communities they serve and in reviewing their fiscal management policies.
W84-00448

6G. Ecologic Impact Of Water Development

LAND USE, NUTRIENT YIELD, AND EUTROPHICATION IN THE CHOWAN RIVER BASIN,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
N. J. Craig, and E. J. Kuenzler.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120872, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Institute Report No 205, North Carolina State Univ., Raleigh, August 1983. 75 p, 16 Tab, 23 Fig, 125 Ref. OWRT B-127-NC(13), 14-34-0001-0274.

Descriptors: *Nonpoint pollution sources, *Water quality, *Eutrophication, *Land use, *Agricultural runoff, *Nutrients, Rivers, Model studies, Watershed management, Nitrogen, Phosphorus, Forests, Cultivated lands, Cropland, Fertilizers, Drainage, Livestock, Animal wastes, Erosion control, Wetlands, Swamps, Cycling nutrients, Nutrient removal, Channeling.

Land use changes within the Chowan River watershed over the past three decades were determined to assess their potential impact on recent water quality degradation and eutrophication of the Chowan River. The amount of harvested cropland has remained constant, but yields from major crops have increased, due partly to increased fertilizer usage. There has been a large increase in artificial drainage on farms from 1940 to 1978, approaching 12% a year. Approximately 67% of the farmland in the North Carolina Chowan watershed is now drained versus 6% in Virginia. A 30% decrease in oak-gum-cypress forested wetland occurred in the N.C. Chowan basin from 1964 to 1974. Swamp forests remove an estimated 83% of the total N and 51% of the total P in streams passing through them. Mass balance models suggested that, of the annual nitrogen inputs to the Chowan River (6.94 x 10 kg N/yr), agriculture contributes 62%, forests and wetlands 21%, and point sources 17%. Of the annual potential phosphorus inputs (3.06 x 10 kg P/yr), agriculture contributes 72%, forests and wetlands 22%, and point sources 6%. Recommendations for reducing nutrient overloading to the Chowan River include use of agricultural Best Management Practices to avoid overloading of soil with fertilizer of animal wastes, and protection of swamp forests so that these wetlands can remove nutrients before they enter the river.
W84-00437

ANALYSES OF NATIVE WATER, BOTTOM MATERIAL, ELUTRIATE SAMPLES AND DREDGED MATERIAL FROM SELECTED SOUTHERN LOUISIANA WATERWAYS AND SELECTED AREAS IN THE GULF OF MEXICO, 1979-81,
Geological Survey, Baton Rouge, LA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00605

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN MISSISSIPPI, JULY 1982,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W84-00654

7. RESOURCES DATA

7A. Network Design

IRRIGATION-WATER QUALITY IN THE SULPHUR CREEK BASIN, YAKIMA AND BENTON COUNTIES, WASHINGTON, APRIL 1976 THROUGH MARCH 1977,
Geological Survey, Tacoma, WA. Water Resources Div.
P. R. Boucher, and M. O. Fretwell.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $11.50 in paper copy, $4.00 in microfiche. USGS Open-File Report 81-1008, 1982. 68 p, 16 Fig, 1 Plate, 17 Tab, 20 Ref, 4 Append.

Descriptors: *Data collection, *Networks, *Monitoring, *Sampling, Irrigation water, Water quality, Sediment yield, Nutrients, Water temperature, Streamflow, Storm runoff, *Washington, Sulphur Creek basin.

A water-quality-sampling network was designed for the Sulphur Creek basin to observe the effects of farming practices on irrigation. Sediment and nutrient yield, discharge, and water temperature data were collected during the 1976 irrigation season and the following fall and winter. The suspended-sediment yield of the basin during this period was 2.0 tons per acre of irrigated cropland. Only about 3% of the net outflow of sediment occurred during the nonirrigation season. The yield computed by subbasin ranged from 0.7 to 7 tons per acre, depending mainly on land slope, but a high percentage of orchard land in the subbasins was probably also significant in reducing loads. Nutrient outflows during the study period were 1,180,000 pounds of nitrogen and 120,000 pounds of phosphorous. Nitrate-plus-nitrite represent 70% of the nitrogen outflow in the irrigation season and 84% in the nonirrigation season. The monitoring network was discontinued at the end of the study period, due largely to insufficient farmer participation. Network sensitivity in the control subbasins was inadequate to detect the effects of a planned demonstration program of best management practices. (USGS)
W84-00541

SELECTED CLIMATIC CHARACTERISTICS OF THE SOUTHEASTERN UINTA BASIN, UTAH AND COLORADO,
Geological Survey, Salt Lake City, UT. Water Resources Div.
For primary bibliographic entry see Field 2B.
W84-00548

INDEX OF SURFACE-WATER STATIONS IN TEXAS, JANUARY 1982,
Geological Survey, Austin, TX. Water Resources Div.
E. R. Carrillo, and H. D. Buckner.
USGS Open-File Report 82-269, 1982. 25 p, 2 Tab, 2 Maps.

Descriptors: *Index of surface-water stations, Data collections, Indexes, Hydrologic data, *Texas.

This index shows the station number and name, type of data collected, and the office principally responsible for the data collection. In addition to the station number and name of the tide-level stations, a permanent numerical designation for gaging stations has been adopted on a nationwide basis; stations are numbered and listed in downstream order. In the downstream direction along the main stem, all stations on a tributary entering above a main-stem station are listed before that station. A tributary entering between two main-stem stations is listed between them. A similar

order is followed in listing stations on first rank, and other ranks of tributaries. To indicate the rank of any tributary on which a gaging station is situated and the stream to which it is an immediate tributary, each indention in the listing of gaging stations represent one rank. This downstream order and system of indention show which gaging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gaging station is situated. (USGS)
W84-00643

INSTRUCTIONS FOR THE SUBMISSION OF DATA TO THE MASTER WATER DATA INDEX,
Geological Survey, Reston, VA. Water Resources Div.
O. O. Williams.
USGS Open-File Report 83-49, 1983. 25 p.

Descriptors: *Data storage and retrieval, *Data processing, *Indexing, *Information systems, Information exchange, Computers, *Master Water Data Index(MWDI), *National Water Data Exchange(NAWDEX).

Instructions are given for the computerized processing of data prepared for entry into the Master Water Data Index of the U.S. Geological Survey's National Water Data Exchange (NAWDEX), as discussed in the manual entitled 'Instructions for the Preparation of Data for the Master Water Data Index.' Two processing procedures are provided: The edit of data and the submission of data for storage in the Master Water Data Index. These instructions are applicable to both new data being submitted for storage and to update transactions for data previously processed and stored. (USGS)
W84-00680

7B. Data Acquisition

GROWTH RESPONSE AND SPECTRAL CHARACTERISTICS OF A SHORT SPARTINA ALTERNIFLORA SALT MARSH IRRIGATED WITH FRESHWATER AND SEWAGE EFFLUENT,
Delaware Univ., Newark. Coll. of Marine Studies.
M. A. Hardisky, R. M. Smart, and V. Klemas.
Remote Sensing of Environment, Vol 13, No 1, p 57-67, 1983. 1 Fig, 3 Tab, 36 Ref.

Descriptors: *Remote sensing, *Marshes, *Wastewater disposal, Spartina, Salt marshes, Biomass, Vegetation, Lewes, Delaware, Radiance, Spectral analysis, Salinity, Effluents, Water pollution effects.

The effects of irrigation with sewage effluent or fresh water were studied in a Spartina alterniflora marsh near Lewes, Delaware. Vegetation response was measured by harvesting biomass and by a hand-held radiometer, which was configured to match bands 3, 4, and 5 of the Landsat-4 Thematic Mapper. Spectral radiance was 0.70 on Julian date 219, 1980, for control and irrigated plots. In the control plot it decreased gradually to 0.68 on date 284, then decreased sharply to <0.60 by date 331. The fresh water and sewage irrigated plots increased in radiance to about 0.73 on day 264 and gradually decreased to 0.62 and 0.66, respectively, by day 331. The radiance data was significantly correlated with live leaf biomass, live-dead leaf biomass ratio and percent live leaf biomass. Radiance data suggested that live leaf biomass production stopped in August in the control plots and continued until October in the treated plots. Apparently the nitrogen additions reduced the rate of canopy senescence. These results indicate that remote sensing could be a viable means of detecting stress and perturbations in Spartina salt marshes. (Cassar-FRC)
W84-00431

SHEDDING SOME LIGHT ON TURBIDITY,
A. M. Crossley.
Water Services, Vol 86, No 1042, p 591-592, 594, 1982. 7 Fig, 3 Tab.

Descriptors: *Turbidity, *Measuring instruments, Turbidimeter, Water quality, Wastewater treatment.

A brief history of the development of methods for measuring turbidity is given. Basic configurations for different types of turbidity measuring devices are described. In basic or probe type instruments, arrangements are made to remove the probe from the liquid and clean the glass manually. The probe is then immersed in a sample of liquid which contains a minimum of suspended solids, and the output from the detector is adjusted to give a zero reading. The probe is then replaced in the liquid and will indicate the obscuration, either in percentage obscuration or NTUs depending on the calibration of the instrument. Some designers of commercially available turbidimeters consider that fouling of the cell windows can cause inaccuracies, and rather than compensate for loss of light transmission, they prefer to provide a method of cleaning the windows. Virtually all modern turbidity meters operate on the principle of optical obscuration; and many designs have been introduced to compensate for aging of lamps and photodetectors and errors due to fouling of the cell windows. However, a few turbidimeters are available in which a different approach has been used. Models are available which are based on the nephelometric principle, with the detector unit totally submersed in the liquid. Still another design is based on the appearance of a final settlement tank as a deep black hole with no apparent bottom. If the tank appears to contain water or other fluid, then some suspended solids are present. (Baker-FRC)
W84-00588

7C. Evaluation, Processing and Publication

SIMULATED STREAMFLOW DATA FOR NORTH CAROLINA,
North Carolina State Univ. at Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 2E.
W84-00492

PRELIMINARY APPRAISAL OF THE HYDROLOGY OF THE BLOCKER AREA, PITTSBURG COUNTY, OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00540

SURFACE-WATER QUALITY DATA FROM SELECTED SITES IN WASHINGTON AFFECTED BY MOUNT ST. HELENS ERUPTIONS: MARCH 27 - SEPTEMBER 30, 1980,
Geological Survey, Tacoma, WA. Water Resources Div.
G. L. Turney, and J. M. Klein.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $20.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 81-1007, 1982. 154 p, 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Data collection, *Surface water, *Water quality, *Volcanoes, Mudflows, *Washington, *Mount St. Helens.

The volcanic eruptions of Mount St. Helens have resulted in the collection of many forms of hydrologic data. Chemical data collected from March 27 to September 30, 1980, to document the effects of the various volcanic events (mudflows, pyroclastic flows, deposition of ash) on the quality of surface water at selected sites in the State of Washington are presented in the report. (USGS)
W84-00542

HYDROLOGY OF AREA 15, EASTERN COAL PROVINCE, KENTUCKY AND TENNESSEE,
Geological Survey, Louisville, KY. Water Resources Div.
D. W. Leist, F. Quinones, D. S. Mull, and M. Young.
USGS Open-File Report 81-809 (WRI), January 1982. 81 p. 46 Ref.

Descriptors: *Hydrologic data, *Water quality, *Groundwater, Surface water, *Coal mines, Geohydrology, *Acid mine drainage, Soils, Floods, Low flows, Water use, Land use, *Kentucky, Eastern Coal Province, Cumberland River, Rockcastle River, Laurel River, Tennessee.

Area 15, in Eastern Kentucky and Tennessee consists of 3,095 square miles in the Cumberland, Rockcastle and Laurel River basins. The area is underlain by Permian, Pennsylvanian, Mississippian rocks. The Breathitt Formation of Pennsylvanian age crops out in about 75% of the area and contains most of the coal. About 22 million tons of coal were produced in the area in 1978, 52% from surface mines. The terrain is steep with acidic soils. Forestry and pastures are the principal land uses. Precipitation ranges from 47 to 54 inches per year, and the 24-hour 10-year frequency storm averages 4.5 inches. Flood prone areas along the rivers have been defined or can be determined from relations with drainage area and physiography. Low flows are poorly sustained, with most streams draining less than 100 square miles approaching a 7-day 10-year minimum flow of zero. Ground water is generally of good quality, although high iron concentrations are common. Sandstones are the principal aquifers. Water levels fluctuate seasonally, and yields of wells are usually less than 50 gallons per minute but range from about 1 to 250. Mine drainage affects the quality of streamflow at most sites in mined basins. Sulfate concentrations are as high as 1,000 milligrams per liter. Other constituents such as iron and manganese also occur in higher concentrations in waters of mined basins. Acid mine drainage generally is neutralized near its source. Most of the water in streams has pH values in the 7-8 range. (USGS)
W84-00543

WATER RESOURCES OF THE GIG HARBOR PENINSULA AND ADJACENT AREAS, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
B. W. Drost.
USGS Open-File Report 81-1021 (WRI), 1982. 148 p, 14 Fig, 1 Plate, 17 Tab, 21 Ref.

Descriptors: *Hydrologic data, *Surface water, Groundwater, *Hydrologic budget, Groundwater recharge, Aquifer characteristics, Saline water, Encroachment, *Washington, Gig Harbor.

The study area is a remnant of a glacial-drift plain nearly surrounded by marine embayments. A water-resources appraisal was made because the area is experiencing rapid population growth. Additional ground water is available for use in the study area. At least 11 cubic feet per second, five times the 1978 rate of use, can probably be obtained. Ground-water quality is generally very good, with minor problems of excess iron, manganese, dissolved solids, chloride, and coliform bacteria. Total flow through the hydrologic system is at an average rate of 254 cubic feet per second, which includes 93 cubic feet per second of ground-water recharge. (USGS)
W84-00544

HYDROLOGIC DATA FOR THE POTOMAC FORMATION IN NEW CASTLE COUNTY, DELAWARE,
Geological Survey, Dover, DE. Water Resources Div.
M. M. Martin, and J. M. Denver.
USGS Open-File Report 81-916 (WRI), 1982. 148 p, 80 Fig, 7 Tab, 40 Ref.

Descriptors: *Hydrologic data, *Groundwater, *Surface water, *Water quality, Wells, Pumpage, Water level, Aquifers, Transmissivity, Storage coefficient, Geohydrology, Chemical analysis, Hydrographs, *Delaware, New Castle County, Potomac Formation.

Hydrologic data for the Potomac Formation in New Castle County, Delaware, consists of records of historical ground-water pumpage, water levels, water quality, and surface-water discharge. Included are well records for 405 wells, and hydrographs

of water levels in 86 wells. Pumpage for 20 well fields are reported. Also included are stream-discharge hydrographs for 6 stations for water years 1979 and 1980, and historical low-flow measurements for 22 stations. In the analysis of 23 aquifer tests, transmissivity and storage coefficient values for the Potomac Formation range from 454 to 8480 square feet per day and 0.0026 to 0.000056, respectively. Vertical hydraulic conductivities of confining beds in the Formation range from 0.0083 to 3.2 feet per day. (USGS)
W84-00545

GEOHYDROLOGY OF PRINCIPAL AQUIFERS IN THE REPUBLICAN RIVER BASIN, KANSAS,
Geological Survey, Garden City, KS. Water Resources Div.
L. E. Dunlap.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver, CO 80225, Price: $15.50 in paper copy, $2.50 in microfiche. USGS Open-File Report 82-79, 1982. 5 Sheets, 25 Ref.

Descriptors: *Aquifers, *Geohydrologic units, *Groundwater, Water table, Groundwater level, *Maps, Irrigation wells, Well yield, Hydrologic data, *Kansas, Republican River basin.

Principal aquifers in the Republican River basin in Kansas are unconsolidated alluvial deposits. One such aquifer is formed by the Ogallala Formation of Miocene age which covers most of the western part of the area. Because saturated thickness of the aquifer decrease northeastward, maximum yields to irrigation wells decrease in that direction from 2,000 to 500 gallons per minute. The Grand Island Formation of Pleistocene age occurs in an ancestral channel of the Republican River in northeast Jewell and northwest Republic counties. The maximum yield to wells from this aquifer was estimated to be 2,000 gallons per minute. Quaternary alluvium of Pleistocene and Holocene age occurs in most major stream valleys. The aquifer in the Republican River valley yields as much as 2,000 gallons per minute to irrigation wells. Water levels in the Ogallala Formation commonly declined from 5 to 40 feet during 1950-77 as a result of irrigation withdrawals. Recharge from irrigation by stream diversions have raised water levels as much as 25 feet in the Grand Island Formation and as much as 15 feet in the Quaternary alluvium of the Prairie Dog Creek valley. (USGS)
W84-00549

POSITION OF THE SALTWATER-FRESHWATER INTERFACE IN THE UPPER PART OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA, 1979,
Geological Survey, Tallahassee, FL. Water Resources Div.
J. D. Fretwell.
USGS Open-File Report 82-90 (WRI), 1982. 1 Sheet, 6 Fig, 1 Tab, 14 Ref.

Descriptors: *Observation wells, *Saline-freshwater interfaces, Aquifers, Monitoring, Groundwater management, Water consumption, Limestone, *Florida, Floridan aquifer.

The position of the saltwater-freshwater transition zone in the Floridan aquifer along coastal southwest Florida is depicted by the 250 milligram per liter line of equal chloride concentration in the upper producing zone of the aquifer. The line was interpolated from chloride concentration data for wells open to the upper producing zone of the aquifer and plotted on a map having a scale of 1:250,000. The line generally lies inland within 5 miles of the coast in areas extending from latitude 29 degrees in Citrus County southward to southern Hillsborough County. In Manatee and Sarasota Counties, the line generally lies with 2 miles of the coast, except in southern Sarasota County where it extends eastward along the Charlotte-DeSoto County line. Knowledge about the position and movement of the 250 milligram per liter line is significant in the effective management of the ground-water resources of coastal areas. The present position of the line will be used as a basis for detecting future movement of the saltwater-freshwater interface. (USGS)
W84-00550

THICKNESS OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1179 (WRI) 1982. 1 Sheet, 2 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic faults, *Southeastern United States.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are hydraulically connected in varying degrees. A map is presented that shows the thickness of the upper permeable zone of the aquifer system. Several types of geologic structures have had an effect on the thickness of the upper permeable zone. The magnitude of this effect varies with the type and size of the structure. (USGS)
W84-00551

SOURCES OF COMPUTER PROGRAMS IN HYDRAULICS.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY5, p 915-922, May, 1980.

Descriptors: *Computer programs, *Mathematical models, *Bibliographies, Publications, Documentation, Hydraulic engineering.

A list is presented of bibliographies and other publications that enumerate mathematical, numerical, and computer models of use to hydraulic engineers. The first part of the list contains sources that are in the form of a formal publication. The second part is composed of ad hoc lists prepared at the request of the Task Committee on Computational Hydraulics or informal lists made for previous projects. Although many computer programs exist, the number of lists and bibliographies is rather small. Thus, the list presented is not exhaustive. (Small-FRC)
W84-00581

TOTAL HARDNESS OF WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
C. L. Sprinkle.
USGS Open-File Report 81-1102 (WRI), 1982. 1 Sheet, 16 Ref.

Descriptors: *Groundwater, *Aquifers, *Hardness, Limestone, Carbonate rocks, Groundwater movement, Geohydrology, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and are hydraulically connected in varying degrees. The upper part of the aquifer system consists primarily of the Tampa, Suwannee, Ocala, and Avon Park Limestones. Based on analyses of water samples from 661 selected wells, a map is presented which shows total hardness in ranges of 0-60, 61-120, 121-180, and greater than 180 mg (as calcium carbonate). Most of the area mapped has water that is hard (121-180 mg) to very hard (greater than 180 mg). (USGS)
W84-00595

SULFATE CONCENTRATION IN WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
C. L. Sprinkle.
USGS Open-File Report 81-1101 (WRI), 1982. 1 Sheet, 28 Ref.

Descriptors: *Groundwater, *Aquifers, *Sulfates, Limestone, Carbonate rocks, Groundwater movement, Geohydrology, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and are hydraulically connected in varying degrees. The upper part of the aquifer system consists primarily of the Tampa, Suwannee, Ocala, and Avon Park Limestones. Based on analyses of water samples from 661 selected wells, a map is presented which shows sulfate concentration in ranges of 0-50, 51-100, 101-250, and greater than 250 mg. Areas of high sulfate concentration are discussed in relation to the predevelopment and modern-day ground-water flow system. (USGS)
W84-00596

THICKNESS OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1124 (WRI), 1982. 1 Sheet, 2 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are hydraulically connected in varying degrees. A map is presented that shows the thickness of the aquifer system. Several types of geologic structures have had an effect on the thickness of the system. The magnitude of this effect varies with the type and size of the structure. (USGS)
W84-00597

GEOLOGY AND CONFIGURATION OF THE BASE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1176 (WRI), 1982. 1 Sheet, 5 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic fractures, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age land that are hydraulically connected in varying degrees. A map is presented that shows at the altitude and configuration of base of the aquifer system. The age and lithology of the different low-permeability materials that mark the base of the system are delineated and briefly described. Several types of geologic structures that affect the configuration of the base of the system may be readily recognized. (USGS)
W84-00598

CONFIGURATION OF THE BASE OF THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1177, (WRI), 1982. 1 Sheet, 8 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic faults, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are

hydraulically connected in varying degrees. The aquifer system consists, in large part, of two major permeable zones separated by a less-permeable unit. A map is presented that shows the altitude and configuration of the base of the upper permeable zone of the system; and the age and lithology of the different low permeability materials that mark the base are delineated and briefly described. Several types of geological structures that affect the configuration of the base of the upper permeable zone may be readily recognized. (USGS)
W84-00599

GEOLOGY AND CONFIGURATION OF THE TOP OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
J. A. Miller.
USGS Open-File Report 81-1178 (WRI), 1982. 1 Sheet, 30 Ref.

Descriptors: *Groundwater, *Aquifers, Carbonate rocks, Limestone, Geohydrology, Geologic faults, *Southeastern U.S., *Maps.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and that are hydraulically connected in varying degrees. A map is presented that shows the altitude and configuration of the top of the aquifer system, as well as the extent of the youngest rock that is judged to be part of the system. Several types of geologic structures that affect the configuration of the top of the system may be readily recognized. (USGS)
W84-00600

HYDROLOGIC DATA FOR URBAN STUDIES IN THE HOUSTON, TEXAS, METROPOLITAN AREA, 1979,
Geological Survey, Houston, TX. Water Resources Div.
F. Liscum, J. F. Weigel, and J. P. Bruchmiller.
USGS Open-File Report 82-164, February 1982, 315 p, 19 Fig, 18 Tab, 6 Ref.

Descriptors: *Rainfall-runoff relationship, Storm runoff, Streamflow, *Data collections, *Urban hydrologic data, Houston, *Texas.

This report contains rainfall and runoff data collected during the 1979 water year for drainage basins in the Houston, Texas, metropolitan area. The information will be useful in determining the extent to which progressive urbanization will affect the yield and mode of occurrence of storm runoff. Rainfall-runoff computations are presented for nine storm periods during the 1979 water year. (USGS)
W84-00602

HYDROLOGIC DATA FOR URBAN STUDIES IN THE DALLAS, TEXAS, METROPOLITAN AREA, 1979,
Geological Survey, Fort Worth, TX. Water Resources Div.
C. M. Wood, H. S. Butler, and J. D. Benton.
USGS Open-File Report 81-491, April 1981, 147 p, 4 Fig, 108 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationship, Storm runoff, Streamflow, *Data collections, *Urban hydrology, Dallas, Dallas County, *Texas.

This report contains rainfall and runoff data collected during the 1979 water year for drainage basins of Joes Creek, Bachman Branch, Turtle Creek, Coombs Creek, Cedar Creek, White Rock Creek, Elam Creek, Fivemile Creek, Whites Branch, Prairie Creek, Tenmile Creek, Buck Creek, and South Mesquite Creek in the Dallas metropolitan area. The information will be useful in determining the extent to which progressive urbanization will affect the yield and mode of occurrence of storm runoff. Rainfall-runoff computations are presented for eight storm periods during the 1979 water year. The report for the 1979 water year completes the Dallas urban project. Hydrologic data contained in this report and in all previous reports of the Dallas and Fort Worth metropolitan areas are being used to prepare an interpretive report entitled 'Effects of urbanization on floods in the Dallas and Fort Worth, Texas, metropolitan areas,' which will be released in 1981. (USGS)
W84-00603

COMPILATION OF SELECTED GROUND-WATER-QUALITY DATA FROM THE SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Sacramento, CA. Water Resources Div.
R. P. Fogelman.
Available from the OFSS, USGS, Box 25425, Fed. Ctr. Denver, CO 80225, Price: $36.25 in paper copy, $3.50 in microfiche.

Descriptors: *California, Groundwater, Water wells, Water analysis, Water chemistry, *Data collections, Water quality, San Joaquin Valley.

The Central Valley of California is one of the most notable structural depressions in the world. It is surrounded by mountains and filled with alluvium derived from those mountains. The San Joaquin Valley is the southern two-thirds of the Central Valley and is bordered on the east by the Sierra Nevada, on the west by the Coast Ranges, on the north by the Sacramento-San Joaquin River Delta area, and on the south by the Tehachapi Mountains. The San Joaquin Valley is probably most noted for its intensive agricultural development, and boasts one of the greatest agricultural economies in the world. The development of ground water has been important to this agricultural boom and subsequently the chemical quality of the ground water is of great interest, especially with respect to maximum agricultural yields as well as domestic uses. This report compiles and summarizes the ground-water-quality data published by the U.S. Geological Survey since about 1950. It includes analyses from more than 5,200 wells. The scope of the study includes the evaluation of the distribution of the water-quality sample by time, aquifer, and area. The distribution is complicated by inconsistencies of sampling with time and area, so time-trend analysis is difficult in most of the area. (USGS)
W84-00604

ANALYSES OF NATIVE WATER, BOTTOM MATERIAL, ELUTRIATE SAMPLES AND DREDGED MATERIAL FROM SELECTED SOUTHERN LOUISIANA WATERWAYS AND SELECTED AREAS IN THE GULF OF MEXICO, 1979-81,
Geological Survey, Baton Rouge, LA. Water Resources Div.
D. L. Lurry.
USGS Open-File Report, 82-690, 1983, 300 p, 11 Fig, 16 Tab, 15 Ref.

Descriptors: *Dredging, *Louisiana, Biochemical oxygen demand, Waste disposal, Effluents, Environmental effects, Nutrients, Pesticides, Trace elements, *Water quality, *Gulf of Mexico, Lower Mississippi River, *Calcasieu River, Mississippi River Gulf Outlet, Intracoastal Waterway, New Orleans to Venice Hurricane Protection Project, *Elutriate.

The U.S. Geological Survey was requested by the U.S. Army Corps of Engineers, New Orleans District, to provide water-quality data to evaluate environmental effects of dredging activities in selected reaches of the Calcasieu River in southwestern Louisiana. Samples were collected from the upper and lower Calcasieu River between January 1980 and March 1981. Thirty-three samples (22 native-water and 11 effluent) were collected from eleven dredging sites. In addition, a series of elutriate studies were conducted between July 1979 and July 1981 to determine water quality as a basis for assessing possible environmental effects of proposed dredging activities in the following areas: Grand Bayou and Martins Canal near Happy Jack, unnamed bayou near Port Sulphur, Grand Bayou and Pipeline Canal near Port Sulphur and Bayou des Plantins near Empire; Mississippi River Gulf Outlet and Inner Harbor Navigation Canal; Southwest Pass; Barataria Bay; Atchafalaya Bay at Eugene Island; Calcasieu Ship Channel. Samples of native water and samples of bottom material were collected from 22 different sites and elutriate (mixtures of native water and bottom material) samples were prepared and analyzed. Four proposed ocean-disposal sites were sampled for bottom material only. Samples were analyzed for selected chemical and biological constituents and physical properties. (USGS)
W84-00605

GROUND-WATER DATA FOR SELECTED COAL AREAS IN WESTERN NORTH DAKOTA,
Geological Survey, Bismarck, ND. Water Resources Div.
J. D. Wald, and S. W. Norbeck.
USGS Open-File Report 83-219, Feb. 1983, 222 p, 13 Fig, 12 Tab, 25 Ref.

Descriptors: *Groundwater, Chemical analysis, *Driller logs, Maps, Data collections, *North Dakota, Fort Union Coal Region.

Ground-water data are provided for the Sand Creek-Hanks, New England-Mott, Dickenson, and Bowman-Gascoyne coal areas, western North Dakota. The report contains the following: (1) Maps showing the location of wells, springs, and test holes; the location of test holes; where driller' logs are available; and the location of wells with chemical analysis; and (2) tables showing well, spring, and test hole records; logs; and chemical analyses of water. (USGS)
W84-00606

HYDROLOGY OF AREA 42, WESTERN REGION, INTERIOR COAL PROVINCE, ARKANSAS,
Geological Survey, Little Rock, AR. Water Resources Div.
C. T. Bryant, F. P. Lyford, K. L. Stafford, and D. M. Johnson.
USGS Water Resources Investigations, Open File Report 82-636, Jan. 1983, 87 p, 46 Fig, 13 Tab, 28 Ref.

Descriptors: *Coal mining, *Strip mines, Hydrologic aspects, Water quality, Surface waters, Subsurface waters, *Arkansas, *Interior coal province, Arkansas Valley coal region, *Arkansas River Basin.

This report is one of a series presenting general hydrologic information in selected coal-mining basins and is designed to be useful to mine owners and operators and consulting engineers in the preparation of requests for mining permits. The western region of the Interior Coal province is divided into seven hydrologic assessment reporting areas. This report is for area 42, located at the southern end of the province, in the Interior Highlands of West-Central Arkansas. The U.S. Geological Survey in this area operates (1981) a network of 20 hydrologic data collection stations to monitor the stream flow. Data collected include rate of flow and water quality information. This report presents data from this effort as well as analyses and interpretations of this and other pertinent data descriptive of the hydrology. (USGS)
W84-00607

HYDROLOGIC DATA FOR URBAN STUDIES IN THE AUSTIN, TEXAS, METROPOLITAN AREA, 1981,
Geological Survey, Austin, TX. Water Resources Div.
R. M. Slade, Jr., J. E. Veenhuis, M. E. Dorsey, H. Gardiner, and A. E. Smith.
USGS Open File Report 83-44, 1983, 309 p, 17 Fig, 21 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationship, Storm runoff, Streamflow, Hydrographs, Mass curves, Hydrologic data, *Data collections, *Urban areas, Water quality, Austin, *Texas, Colorado River(Tex), Balcones Escarpment, Edwards aquifer.

Rainfall and runoff data collected during the 1981 water year for the Austin, Texas metropolitan area are reported. In 1975, the program was expanded to include the collection of water-quality data. In 1978, the program was expanded to include a ground-water resources study of the south Austin metropolitan area in the Balcones Fault Zone. The information will be useful in determining the effect of urbanization on flood peaks, volume, and water quality. The major streams in the study area are Onion Creek, Baron Creek, Walnut Creek, Bull Creek, Boggy Creek, Shoal Creek, Williamson Creek, Slaughter Creek, Bear Creek, and Waller Creek. All streams in the area are within the Colorado River basin. Detailed rainfall-runoff computations are presented for several storms during the 1981 water year. Water-quality data for sites in the Austin metropolitan area are also given in this report. (USGS)
W84-00608

DEVELOPMENT OF GROUND-WATER RESOURCES IN ORANGE COUNTY TEXAS, AND ADJACENT AREAS IN TEXAS AND LOUISIANA, 1971-80,
Geological Survey, Austin, TX. Water Resources Div.
C. W. Bonnet, and R. K. Gabrysch.
USGS Open-File Report 82-330, 1982. 57 p, 11 Fig, 5 Tab, 18 Ref.

Descriptors: *Groundwater, *Aquifers, *Water levels, Drillers logs, Observation wells, Chemical analyses, Saline water encroachment, Chlorides, Pumpage, Land-surface subsidence, Orange County, *Texas, Louisiana.

The major water-bearing unit in the study area is the Chicot aquifer. The Chicot aquifer overlies the Evangeline aquifer. The Evangeline aquifer is undeveloped in Orange County, but is developed at Evadale in Jasper County, Texas, and at Silsbee in Hardin County, Texas. Both aquifers consist of unconsolidated and discontinuous layers of sand and clay that dip toward the Gulf of Mexico. Pumpage in Orange County from the lower unit of the Chicot aquifer averaged 21.2 million gallons per day and pumpage from the upper unit of the Chicot averaged about 2 million gallons per day from 1971-79. Pumpage increased in municipal areas and decreased in industrial areas with little net change in total pumpage during the report period. Most water levels continued to decline in Orange County, generally at a slower rate than before 1971. Water levels tended to stabilize in areas where ground-water withdrawals decreased. In some of the areas water levels rose. Bench-mark elevations determined during 1973 show regional land-surface subsidence from 1918-73, generally attributed to ground-water development, to be less than 0.5 foot. Locally, subsidence due to production of oil, gas, saltwater, or sulphur was about 15 feet at Spindletop Dome, Jefferson County, Texas, and as much as 3 feet (.9 meter) near Port Acres gas field, Jefferson County, Texas. Although saltwater encroachment is evident in parts of southern Orange County, the encroachment is not expected to increase because artesian pressure is unlikely to be decreased further due to stable ground-water pumping and a projected increase in the use of surface water to meet future demands. (USGS)
W84-00610

AVAILABILITY AND QUALITY OF WATER FROM THE DAKOTA AQUIFER, NORTHWEST IOWA,
Geological Survey, Iowa City, IA. Water Resources Div.
M. R. Burkhart.
USGS Open-File Report 82-264, (1982). 118 p, 11 Fig, 5 Tab, 15 Ref.

Descriptors: *Iowa, *Aquifer, *Water quality, Irrigation, Sulfates, Dakota aquifer, *Water availability.

The Dakota aquifer in northwest Iowa consists of sandstones in the Dakota Formation. Sandstone beds are from less than 10 to more than 150 feet thick and cumulatively total more than 200 feet throughout much of the area. The aquifer is confined by shale, carbonate rocks, till and loess. Water flows from the north-central part of the area to the south and southwest. Recharge is through leakage from above. Discharge is to underlying aquifers and alluvium along the Missouri and Big Sioux Rivers. An average hydraulic conductivity of 300 gallons per day per foot squared was used to estimate potential yield to wells. Yields of more than 350 gallons per minute can be commonly expected and more than 1000 gallons per minute can be produced in some areas. The quality of water from the Dakota is a calcium-magnesium-sulfate type which is generally suitable for irrigation. Water quality may be locally altered by leakage from the underlying Paleozoic aquifers if withdrawals reverse the natural flow from the Dakota into the Paleozoic. Such a reversal may exist around the City of LeMars. The presence of radionuclides exceeds recommended limits at several sites. (USGS)
W84-00611

DRAINAGE DIVIDES, MASSACHUSETTS--HUDSON RIVER BASIN, BOSTON, MASSACHUSETTS,
Geological Survey, Boston, MA. Water Resources Div.
S. Wandle, Jr.
USGS Open-File Report 81-1199, 1982. 2 p, 5 Maps.

Descriptors: *Drainage basins, Surface waters, *Massachusetts, *Hydrologic data, *Maps, Data collections, Hudson River, Northern Berkshire County.

Drainage boundaries for selected subbasins in northern Berkshire County, Massachusetts, are delineated on five topographic quadrangle maps at a scale of 1:24,000. Drainage basins are shown for all U.S. Geological Survey data-collection sites and for mouths of major rivers. Drainage basins are shown for the outlets of lakes or ponds and for rivers where the drainage area is greater than 3 square miles. Successive sites are indicated where the intervening area is at least 6 square miles on tributary streams and 10 square miles along the Hoosic or North Branch Noosic Rivers. (USGS)
W84-00612

GROUND-WATER RESOURCES IN THE HOOD BASIN, OREGON,
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00613

GROUND-WATER PUMPAGE IN NASSAU COUNTY, LONG ISLAND, NEW YORK, 1920-77, INTRODUCTION AND USER'S GUIDE TO THE DATA COMPILATION,
Geological Survey, Syosset, NY. Water Resources Div.
C. Kilburn.
USGS Open-File Report 81-499, 1982. 25 p, 2 Maps, 2 Tab, 1 Ref.

Descriptors: *Groundwater, *Withdrawal, *Well data, *New York, Nassau County, Long Island, *Ground-water pumpage.

Pumpage data from about 2,100 wells used for public and nonpublic water-supply in Nassau County from 1920-77 have been collected and are available for public inspection at the U.S. Geological Survey office in Syosset, Nassau County. Except for wells in use before 1920, these data constitute the entire record available through 1977. The data are divided into two categories--pumpage from wells used for public supply, and pumpage from wells used mainly for industrial and commercial uses, designated as nonpublic water supply. Pumpage is tabulated by well or well field and is given by month or year with an annual total. The report serves as an introduction and user's manual to the data, which are available for inspection but are not included in the report because they fill several hundred pages. The report describes the method of reporting pumpage on Long Island and how pumpage values were derived from the records. It also includes well-completion data and two maps showing the location of all wells. (USGS)
W84-00614

GROUND-WATER DATA FOR GEORGIA, 1980,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 2F.
W84-00615

RECORDS OF WATER LEVELS IN THE BIG SIOUX AQUIFER, MINNEHAHA COUNTY, SOUTH DAKOTA, 1981,
Geological Survey, Huron, SD. Water Resources Div.
D. R. Winter.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $3.50 in paper copy, $3.50 in microfiche. USGS Open-File Report 82-1020, 1983. 25 p, 2 Fig, 1 Tab, 1 Ref.

Descriptors: *Data collection, *Hydrologic data, *Water levels, Water wells, *South Dakota, Minnehaha County, Big Sioux aquifer.

Water levels in the Big Sioux aquifer measured by the U.S. Geological Survey in 1981 are presented in tabular and graphic form. (USGS)
W84-00649

QUALITY-OF-WATER DATA AND STATISTICAL SUMMARY FOR SELECTED COAL-MINED STRIP PITS IN CRAWFORD AND CHEROKEE COUNTIES, SOUTHEASTERN KANSAS,
Geological Survey, Lawrence, KS. Water Resources Div.
L. M. Pope, and A. M. Diaz.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $3.50 in paper copy, $1.00 in microfiche. USGS Open-File Report 82-1021, 1982. 29 p, 4 Fig, 6 Tab, 8 Ref.

Descriptors: *Water quality data, *Strip mines, Statistical analysis, Regression analysis, Water pollution, Crawford County, Cherokee Counties, *Kansas.

Quality-of-water data, collected October 21-23, 1980, and a statistical summary are presented for 42 coal-mined strip pits in Crawford and Cherokee Counties, Southeastern Kansas. The statistical summary includes minimum and maximum observed values, mean, and standard deviation. Simple linear regression equations relating specific conductance, dissolved solids, and acidity to concentrations of dissolved solids, sulfate, calcium, and magnesium, potassium, aluminum, and iron are also presented. (USGS)
W84-00650

CONFIGURATION OF THE WATER TABLE, MARCH 1980, IN THE SNAKE RIVER PLAIN REGIONAL AQUIFER SYSTEM, IDAHO AND EASTERN OREGON,
Geological Survey, Boise, ID. Water Resources Div.
G. F. Lindholm, S. P. Garabedian, G. D. Newton, and R. L. Whitehead.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $2.25 in paper copy, $1.00 in microfiche. USGS Open-File Report (Map), 1983. 1 p, 1 Fig.

Descriptors: *Water table, *Aquifer systems, Groundwater movement, Snake River Plain, *Idaho, *Oregon, *Water levels, Regional studies, *Maps.

A regional map of the water table in the Snake River Plain, Idaho and Eastern Oregon, was drawn from about 1,600 water-level measurements made in March 1980. Contour intervals are 50, 100, and 200 feet. In most of the plain, the regional aquifer is unconfined; however, in places, water occurs under semiconfined to confined conditions. Where confined, variations in head with depth are

small, within the range of the contour interval. The map was prepared as part of the Snake River Plain RASA (Regional Aquifer System Analysis) study. W84-00651

CHLORIDE CONCENTRATION IN WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN EASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
C. L. Sprinkle.
USGS Open-File Report 81-1103 (WRI), 1982. 1 Sheet, 29 Ref.

Descriptors: *Groundwater, *Aquifers, *Chlorides, Limestone, Carbonate rocks, Groundwater movement, Geohydrology, *Southeast U.S.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that vary in age and are hydraulically connected in varying degrees. The upper part of the aquifer system consists primarily of the Tampa, Suwannee, Ocala, and Avon Park Limestones. Based on analyses of water samples from 661 selected wells, a map is presented which shows chloride concentration in ranges of 0-250, 251-500, 501-1,000, and greater than 1,000 mg/. Areas of high chloride concentration are discussed in relation to the predevelopment and modern-day ground-water flow system. (USGS)
W84-00652

DISSOLVED-SOLIDS CONCENTRATION IN WATER FROM THE UPPER PERMEABLE ZONE OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES,
Geological Survey, Atlanta, GA. Water Resources Div.
C. L. Sprinkle.
USGS Open-File Report 82-94 (WRI), 1982. 1 Sheet, 30 Ref.

Descriptors: *Groundwater, *Aquifers, *Dissolved solids, Limestone, Carbonate rocks, Groundwater movement, Geohydrology, *Southeast U.S.

The Tertiary limestone aquifer system of the southeastern United States is a thick sequence of carbonate rocks that range from Paleocene to Miocene in age and are hydraulically connected in varying degrees. The upper permeable zone of the aquifer system consists of the Tampa, Suwannee, Ocala, and Avon Park Limestones. Based on analyses of water samples from 591 selected wells, a map is presented which shows dissolved-solids concentration in ranges of 0-250, 251-500, 501-1,000, and greater than 1,000 mg/. Dissolved-solids concentrations and hydrochemical facies developed within the aquifer system are related to the predevelopment and modern-day ground-water flow system. (USGS)
W84-00653

BACKGROUND HYDROLOGIC INFORMATION IN POTENTIAL LIGNITE MINING AREAS IN MISSISSIPPI, JULY 1982,
Geological Survey, Jackson, MS. Water Resources Div.
S. J. Kalkhoff.
USGS Open-File Report 83-257, 1983. 25 p, 3 Fig, 3 Tab, 4 Ref.

Descriptors: *Water quality, *Lignite, *Mining, Land use, *Mississippi, Oktibbeha County, Choctaw County, Noxubee County, Winston County.

A water-quality sampling program was initiated in 1980 to determine background hydrologic data in potential lignite mining areas of Mississippi. This report is the third in a planned five-part series to provide data to assess future impacts of mining on small streams. The data indicates that most streams in the study area have a dissolved-solids concentration less than 100 mg/. The major ion concentrations were generally less than 10 mg/. Concentrations of arsenic, cadmium, mercury, and selenium in bottom material samples were below detectable limits. Cobalt, lead, zinc, copper, and chromium concentrations exceeded 10 micro-/g at all sites and maganese exceeded 1000 micro-/g at five sites. (USGS)
W84-00654

FLOODS FROM SMALL DRAINAGE AREAS IN ALASKA,
Geological Survey, Anchorage, AK. Water Resources Div.
S. H. Jones.
USGS Open-File Report 83-258, 1983. 54 p, 22 Fig, 5 Tab, 17 Ref.

Descriptors: Floods, Flood characteristics, *Flood hydrographs, *Flood peaks, Flood frequency, *Drainage areas, *Data collections, *Alaska, Crest-stage gages.

Flood peak-stage and associated discharge data collected since 1963 in small (generally less than 100 square miles) drainage areas in Alaska are presented in tabular and graphical form. The report also contains table of computed magnitudes of floods at selected recurrence intervals (2, 5, 10, 25, and 50 years) for sites having 10 or more years of record. Data have been collected at approximately 125 sites since the 'small-streams program' began in 1963; 64 crest-stage gages and 3 continuous recording gages are being operated in 1983. (USGS)
W84-00659

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2B: SOUTH FLORIDA - GROUND WATER.
Geological Survey, Miami, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-244277, Price codes: A17 in paper copy, A01 in microfiche. USGS Water-Data Report FL-81-2B, 1982. 376 p, 17 Fig, 1 Tab.

Descriptors: *Florida, *Hydrologic data, Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections, South Florida.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, periodic stage for 82 streams, peak discharge for 78 streams, and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 488 wells, and periodic ground water levels for 525 wells; and miscellaneous water level measurements for 2,317 wells; quality of water data for 444 surface water sites and 613 wells. The data for south Florida includes continuous or daily discharge for 84 streams, periodic discharge for 2 streams, peak discharge for 2 streams, continuous or daily stage for 21 streams, and periodic stage for 47 streams; continuous elevations for 15 lakes, and periodic elevations for 6 lakes; continuous ground water levels for 183 wells, periodic ground water levels for 160 wells, and miscellaneous water level measurements for 544 wells; quality of water for 146 surface water sites and for 269 wells. (USGS)
W84-00660

WATER RESOURCES DATA FLORIDA, WATER YEAR 1981, VOLUME 2A: SOUTH FLORIDA - SURFACE WATER.
Geological Survey, Miami, FL. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-244269, Price codes: A21 in paper copy, A01 in microfiche. USGS Water-Data Report FL-81-2A, 1982. 483 p, 14 Fig, 1 Tab. Prepared in cooperation with the State of Florida and other agencies.

Descriptors: *Florida, *Hydrologic data, *Surface water, Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Elevations, Water wells, *Data collections, South Florida.

Water resources data for the 1981 water year in Florida consists of continuous or daily discharge for 279 streams, periodic discharge for 52 streams, continuous or daily stage for 64 streams, periodic stage for 82 streams, peak discharge for 78 streams, and peak stage for 55 streams; continuous or daily elevations for 77 lakes, periodic elevations for 144 lakes; continuous ground water levels for 488 wells, and periodic ground water levels for 525 wells; and miscellaneous water level measurements for 2,317 wells; quality of water data for 444 surface water sites and 613 wells. The data for south Florida includes continuous or daily discharge for 84 streams, periodic discharge for 2 streams, peak discharge for 2 streams, continuous or daily stage for 21 streams, and periodic stage for 47 streams; continuous elevations for 15 lakes, and periodic elevations for 6 lakes; continuous ground water levels for 183 wells, periodic ground water levels for 160 wells, and miscellaneous water level measurements for 544 wells; quality of water for 146 surface water sites and for 269 wells. (USGS)
W84-00661

WATER RESOURCES DATA--VIRGINIA, WATER YEAR 1982,
Geological Survey, Richmond, VA. Water Resources Div.
B. J. Prugh, Jr, F. J. Easton, and D. D. Lynch.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-103192, Price codes: A21 in paper copy, A01 in microfiche. USGS Water Data Report VA-82-1, 1983. 460 p, 6 Fig, 3 Tab. Prepared in cooperation with the State of Virginia and with other agencies.

Descriptors: *Virginia, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collections.

Water resources data for the 1982 water year for Virginia consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 200 gaging stations; stage only at 1 gaging station; stage and contents at 10 lakes and reservoirs; water quality at 32 gaging stations and 8 wells; and water levels at 59 observation wells. Also included are data for 73 crest-stage partial-record stations. Locations of these sites are shown. Additional water data were collected at various sites not involved in the systematic data-collection program. Discharge measurements were made at 41 coal-monitoring partial-record stations and at 199 low-flow partial-record station. Miscellaneous data were collected at 119 measuring sites and 94 water-quality sampling sites. (USGS)
W84-00662

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 2. EASTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-245092, Price codes: A13 in paper copy, A01 in microfiche. USGS Water-Data Report WA-81-2, (April 1983). 276 p, 19 Fig. Prepared in cooperation with the State of Washington and with other agencies.

Descriptors: *Washington, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, Eastern Washington.

Water-resources data for the 1981 water year for the eastern region of Washington consist of

records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground-water wells. This report, in two volumes, contains records for water discharge at 229 gaging stations; stage only at 5 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 39 gaging stations (including 6 lakes and reservoirs) and 100 wells; and water levels at 164 observation wells. Also included are data for 14 crest-stage and 28 water-quality partial-record stations. Locations of sites in this volume are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-00663

WATER RESOURCES DATA FOR WASHINGTON WATER YEAR 1981, VOLUME 1. WESTERN WASHINGTON.
Geological Survey, Tacoma, WA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-245084. Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report WA-81-1, (April 1983). 337 p, 22 Fig. Prepared in cooperation with the State of Washington and with other agencies.

Descriptors: *Washington, *Hydrologic data, *Groundwater, *Surface water, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes, Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, Western Washington.

Water-resources data for the 1981 water year for the western region of Washington consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of groundwater wells. This report, in two volumes, contains records for water discharge at 229 gaging stations; stage only at 5 gaging stations; stage and contents at 39 lakes and reservoirs; water quality at 39 gaging stations (including 6 lakes and reservoirs) and 100 wells; and water levels at 164 observation wells. Also included are data for 14 crest-stage and 28 water-quality partial-record stations. Locations of sites in this volume are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-00664

WATER RESOURCES DATA FOR ARIZONA, 1981.
Geological Survey, Tucson, AZ. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-243907, Price codes: A23 in paper copy, A01 in microfiche. USGS Water-Data Report AZ-81-1, (February 1983). 532 p., 8 Fig. Prepared in cooperation with the State of Arizona and with other agencies.

Descriptors: *Arizona, *Hydrologic data, *Surface water, *Groundwater, *Water quality, Flow rate, Gaging stations, Lakes reservoirs, Chemical analyses, Sediment, Water temperatures, Sampling sites, Water levels, Water analyses, *Data collection.

Water resources data for the 1981 water year for Arizona consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; water levels of observation wells; and quality of ground water. This report contains discharge records for 237 gaging stations, annual peaks for 41 crest-stage partial-record stations, and discharge measurements at 90 miscellaneous sites; contents only records for 9 lakes and reservoirs; stage and contents for 1 lake; elevation and discharge for 1 streamflow station; elevation only for 1 streamflow station; 16 supplementary records, included with gaging-station records, consisting of monthend or monthly stage, contents, and evaporation of lakes and reservoirs, diversions, and return flows; water-quality records for 64 continuous-record stations and 5 miscellaneous sites; water levels for 104 observation wells; and water-quality data for water from 752 wells. (USGS)
W84-00665

WATER RESOURCES DATA FOR PENNSYLVANIA WATER 1981, VOLUME 1. DELAWARE RIVER BASIN.
Geological Survey, Harrisburg, PA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB83-244251, Price codes: A15 in paper copy, A01 in microfiche. USGS Water-Data Report PA-81-1, 1982. 327 p, 9 Fig.

Descriptors: *Pennsylvania, *Hydrologic data, *Groundwater, *Surface waters, *Water quality, Gaging stations, Streamflow, Flow rates, Lakes Reservoirs, Chemical analysis, Sediments, Water temperature, Water analysis, Water levels, Water wells, *Data collections, Sites, *Delaware River Basin.

Water resources data for the 1981 water year for Pennsylvania consist of records of discharge and water quality of streams; elevation and contents of lakes and reservoirs; and elevation of tides; and water levels of ground-water wells. This volume contains records for water discharge at 71 gaging stations; elevation and contents at 11 lakes and reservoirs; elevation of tides at 1 gaging station; water quality at 40 gaging stations; and water levels at 16 observation wells. Also included are data for 37 crest-stage, 90 low flow, and 43 water-quality partial-record stations. Locations of these sites are shown. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements and analyses. (USGS)
W84-00666

HYDROGEOLOGY OF SIGNIFICANT SAND AND GRAVEL AQUIFERS - NORTHERN YORK AND SOUTHERN CUMBERLAND COUNTIES, MAINE,
Geological Survey, Boise, ID. Water Resources Div.
A. L. Tolman, D. H. Tepper, G. C. Prescott, Jr., and S. O. Gammon.
USGS Open-File Report 83-1, 1983. 4 Maps, 30 Ref.

Descriptors: *Areal hydrogeology, *Glacial aquifers, *Glacial sediments, *Water quality, *Groundwater pollution, Groundwater availability, Well yield, Seismology, Resistivity, Water pollution sources, Water table fluctuations, *Maps, *Maine, Northern York County, Southern Cumberland County.

This reconnaissance-level hydrogeologic study covers an area of 875 square miles in northern York and southern Cumberland Counties, Maine. This region contains the densest concentration of both aquifers and population in the State, and was selected for study in preparation for management and protection programs being developed at the State and Federal level. This map report includes: identification and mapping of boundaries of approximately 172 square miles of significant aquifers; estimated aquifer yields; depth to water table; depth to bedrock/thickness of unconsolidated deposits; bedrock surface topography; stratigraphy and stratigraphic relationships; characterization of regional ground-water chemistry; and assessments of the effects of 37 potential contamination sites on ground-water quality. The aquifers within the study area are typically less than 50 feet thick, become finer-grained with depth, and are underlain by marine deposits or till. About 10 square miles of the aquifers studied can sustain well yields of more than 50 gallons per minute but few of these aquifers are capable of yielding quantities sufficient for industrial or municipal water supplies. The regional ground-water, based on samples from 23 wells, has the following chemical characteristics: it is slightly acidic to neutral; has less than 100 milligrams per liter of dissolved solids; sodium, calcium, and magnesium are the dominant cations; bicarbonate is the solids; sodium, calcium, and magnesium are the dominant cations; bicarbonate is the dominant anion; and the water is soft. The regional ground-water quality is excellent but concentrations of iron and manganese are high enough in some localities to limit the practical use of the water without treatment. Although none of the 37 ground-water contamination sites investigated has a severe impact on ground-water quality, the cumulative impacts of these sites may have regional significance. (USGS)
W84-00667

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. A. Bradner.
USGS Open-File Report 83-41, 1983. 1 p, 1 Fig.

Descriptors: Potentiometric level, *Groundwater, Hydrologic aspects, *Aquifer, Hydrogeology, *Maps, *Sumter County, *Florida.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Florida, for May 1982. The Floridan aquifer is the principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the low water-level period. Water-level measurements were made at approximately 60 wells. The potentiometric surface ranged in altitude from more than 95 feet in the southeast part of the county to less than 35 feet northwest of Lake Panasoffkee in the west-central area. (USGS)
W84-00668

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, MAY 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. L. Barr, and G. R. Schiner.
Available from the OFSS, USGS Box 25425, Fed. Ctr. Denver CO 80225, Price: $1.75 in paper copy, $1.00 in microfiche. USGS Open-File Report 82-697, May 1982. Map, 1 Fig, 2 Ref.

Descriptors: *Potentiometric level, *Potentiometric flow, Hydrology, Hydrogeology, Water levels, *Maps, *Florida, Southwest Florida Water Management District.

A May 1982 potentiometric surface map of the Southwest Florida Water Management District depicts the annual low water-level period. Water levels in most wells measured in May 1982 were lower than in September 1981. Levels averaged about 9 feet lower in the southern part of the area and 1.5 feet lower in the north. In agricultural areas of southern Hillsborough, Manatee, southwestern Polk, southern Hardee, northwestern De Soto, and northern Sarasota Counties, water-level declines ranged from 5 feet to 29 feet. From May 1981 to May 1982, water-level increases ranged from about 3 feet in the northern counties to about 20 feet in the middle and southern counties. Water-level increases were about 4 feet in the extreme southern part of the study area. (USGS)
W84-00669

APPLICATIONS SYSTEMS VERIFICATION AND TRANSFER PROJECT, VOL. II, OPERATIONAL APPLICATIONS OF SATELLITE SNOW-COVER OBSERVATIONS AND DATA-COLLECTION SYSTEMS IN THE ARIZONA TEST SITE,
Geological Survey, Phoenix, AZ. Water Resources Div.
H. H. Schumann.
National Aeronautics and Space Administration Technical Paper 1823, December 1981. 80 p, 33 Fig, 9 Tab, 22 Ref.

Descriptors: *Snow cover, *Snowmelt-runoff, *Satellite remote sensing, Remote sensing, *Satellite data collection, *Telemetry, Hydrologic

models, Satellites-meteorology, Runoff-prediction models, *Arizona, Arizona test site, Salt-Verde watershed.

The operation of multipurpose reservoirs in semiarid central Arizona requires timely and dependable streamflow and snowmelt information. Since 1965, conventional ground surveys and aerial observations have been used in an attempt to monitor rapidly changing moisture conditions in the Salt-Verde watershed. Since 1974, repetitive satellite snow-cover observations have greatly reduced the necessity for frequent routine aerial snow-reconnaissance flights over the mountains. Although several types of satellite imagery can provide the synoptic coverage necessary to map the large snow-covered areas in the 34,000-square-kilometer watershed, frequent repetitive coverage is required to monitor the rapid changes in snow cover. High-resolution (80 meter) multi-spectral imagery provided by the Landsat satellite series enabled rapid and accurate mapping of snow-cover distributions for small- to medium-sized subwatersheds; however, Landsat imagery provided only one observation every 9 days of about a third of the watershed. Low-resolution 1 kilometer) imagery acquired by the ITOS and SMS/GOES meteorological satellite series provides the daily synoptic observation necessary to monitor the rapid changes in snow-covered area in the entire watershed. A comparison of snow-covered area measurements and corresponding mean daily runoff rates indicates that short-term runoff volumes can be predicted from daily sequential satellite snow-cover observations. Seasonal runoff predictions have been improved by use of a modified hydrometeorological model.
W84-00670

WATER-LEVEL MAPS OF THE MISSISSIPPI ALLUVIAL AQUIFER, NORTHWESTERN MISSISSIPPI, SEPTEMBER 1982,
Geological Survey, Jackson, MS. Water Resources Div.
D. Darden.
USGS Water-Resources Investigations Report 83-4133, 1983. 1 Map, 5 Fig, 8 Ref.

Descriptors: *Mississippi, *Groundwater, *Aquifer, Water levels, *Maps, Mississippi River valley alluvial aquifer, Quarternary aquifers.

Water levels were measured in about 500 wells in the Mississippi River valley alluvial aquifer in northwestern Mississippi during September 13-24, 1982. The water-level change from September 1981 to September 1982 showed some recovery, but the depth-to-water map showed areas of continual water-level decline in the central part of the Delta. Water levels in the Delta were higher along the Mississippi River and Bluff Hills and Yazoo River. Historically, water levels decline and rise as the amount of precipitation decreases or increases. Recently, continuous heavy pumping for irrigation has caused general water-level declines in the alluvial aquifer. (USGS)
W84-00671

ALTITUDE AND CONFIGURATION OF THE PREDEVELOPMENT WATER TABLE IN THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
USGS Open-File Report 82-275 (WRI), March 1982, 2 Sheets, 11 Ref.

Descriptors: *Groundwater, *Aquifers, *Water table, Bedrock, *Oklahoma, *High Plains Regional Aquifer System, *Maps.

The High Plains aquifer in Oklahoma is part of a regional aquifer system extending from South Dakota southward to Texas and New Mexico. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, principally of Quaternary age. During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the aquifer and to develop and evaluate predictive computer models of it. This report consists of two maps showing the altitude and configuration of the predevelopment water table in the eastern area and the Panhandle area. The water table generally sloped from west to east at an average rate of about 14 feet per mile. The altitude of the water table ranged from about 4,650 feet in Cimarron County to about 1,950 feet in Woodward County. (USGS)
W84-00672

GENERALIZED ALTITUDE AND CONFIGURATION OF THE BASE OF THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
USGS Open-File Report 81-1117 (WRI) March 1982, 2 Sheets, 25 Ref.

Descriptors: *Aquifers, Bedrock, *Oklahoma, *High Plains Regional Aquifer System, *Maps.

The High Plains aquifer in Oklahoma is part of a regional aquifer system extending from South Dakota on the north to Texas and New Mexico on the south. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, principally of Quaternary age. During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the aquifer and to develop predictive computer models of it. This report consists of two maps showing the altitude and configuration of the eroded pre-Ogallala bedrock surface, the base of the aquifer. Bedrock slopes generally from west to east and is composed of rocks of Permian, Triassic Jurassic, and Cretaceous age. Altitudes of the aquifer base were determined from drillers' logs and from published and unpublished information. (USGS)
W84-00673

ALTITUDE AND CONFIGURATION OF THE 1980 WATER TABLE IN THE HIGH PLAINS REGIONAL AQUIFER, NORTHWESTERN OKLAHOMA,
Geological Survey, Oklahoma City, OK. Water Resources Div.
J. S. Havens.
USGS Open-File Report 82-100 (WRI), March 1982. 2 Sheets, 6 Ref.

Descriptors: *Groundwater, *Aquifers, *Water table, Bedrock, *Oklahoma, *High Plains Regional Aquifer System, *Maps.

The High Plains aquifer in Oklahoma is part of a regional aquifer system extending from South Dakota southward to Texas and New Mexico. The principal aquifer, the Ogallala Formation of Tertiary age, is hydraulically connected with other unconsolidated deposits, principally of Quaternary age. During 1978, the U.S. Geological Survey began a 5-year study of the High Plains regional aquifer system to provide hydrologic information for evaluation of the aquifer and to develop and evaluate the predictive computer models of it. This report consists of two maps showing the altitudes and configuration of the 1980 water table in the eastern area and the Panhandle area. The water table generally slopes 14 feet per mile. The altitude of the water table ranges from about 4,650 feet in Cimarron County to about 2,000 feet in Woodward County. (USGS)
W84-00674

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN THE ST. JOHNS RIVER WATER MANAGEMENT DISTRICT AND VICINITY, FLORIDA, SEPTEMBER 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. R. Schiner, and E. C. Hayes.
Available from the OFSS, USGS, Lakewood, CO 80225, Paper copy $3.50; Microfiche $1.00. USGS Open-File Report 83-30, 1983. 1 p, 1 Fig.

Descriptors: *Potentiometric level, *Groundwater, Hydrologic aspects, *Aquifer, Hydrogeology, *Maps, *Florida, St. Johns River Water Management District.

This map presents the potentiometric surface of the Floridan aquifer in the St. Johns River Water Management District and vicinity for September 1982. The Floridan aquifer is the principal source of potable water in the area. Water-level measurements were made on approximately 1,000 wells and on several springs. The potentiometric surface is shown mostly by 5-foot contour intervals. In the Fernandina Beach area a 40-foot interval is used to show a deep cone of depression. The potentiometric surface ranged from 131 feet above NGVD (National Geodetic Vertical Datum of 1929) in Polk County to 68 feet below NGVD in Nassau County. Water levels continued to recover from record low levels set in September 1981. Except in a few places, water levels throughout the District rose above September 1981 levels. September 1982 levels were as much as 10 feet and commonly 2 to 3 feet higher than the below normal September 1981 levels. (USGS)
W84-00675

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER, SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT, SEPTEMBER 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
G. L. Barr, and G. R. Schiner.
Available from the OFSS, USGS, Fed. Ctr. Lakewood CO 80225, Price: $1.75 in paper copy, $1.00 in microfiche. Open-File Report (Map) 82-1011, September 1982, 1 p, 1 Fig, 2 Ref.

Descriptors: *Potentiometric level, *Potentiometric flow, Hydrology, Hydrogeology, *Maps, *Water levels, *Florida, Southwest Florida Water Management District.

A September 1982 potentiometric surface map of the Southwest Florida Water Management District depicts the annual high water-level period. Water levels in most wells measured in September 1982 were higher than in May 1982. Levels averaged about 12 feet higher in the southern part of the area and about 5 feet higher in the north. In agricultural areas of southeastern Hillsborough, Manatee, southwestern Polk, Hardee, northwestern De Soto, and northern Sarasota Counties, water-level increases ranged from 1 to 27 feet. From September 1981 to September 1982, water-level changes ranged from slight decreases in some parts of the study area to 1- to 22-foot increases in the major part of the study area. (USGS)
W84-00676

POTENTIOMETRIC SURFACE OF THE FLORIDAN AQUIFER IN CENTRAL SUMTER COUNTY, FLORIDA, SEPTEMBER 1982,
Geological Survey, Tallahassee, FL. Water Resources Div.
L. A. Bradner.
USGS Open-File Report 83-42, 1983. 1 p, 1 Fig.

Descriptors: *Potentiometric level, *Groundwater, Hydrologic aspects, Aquifer, Hydrogeology, *Maps, Sumter County, *Florida.

This map presents the potentiometric surface of the Floridan aquifer in central Sumter County, Florida, for September 1982. The Floridan aquifer is principal source of potable water in the area. The focus of the map is the potentiometric surface in the Jumper Creek Canal area for the high water-level period. Water-level measurements were made on approximately 60 wells. The potentiometric surface ranged in altitude from more than 90 feet in the southeast part of the county to less than 40 feet northwest of Lake Panasoffkee in the west-central area.
W84-00677

SUPPLEMENT TO THE NEW MEXICO THREE-DIMENSIONAL MODEL (SUPPLEMENT TO OPEN-FILE REPORT 80-421),

Geological Survey, Albuquerque, NM. Water Resources Div.
G. A. Hearne.
USGS Open-File Report 82-857, 1982. 163 p, 5 Fig, 8 Tab, 5 Ref.

Descriptors: *Computer programs, *Documentation, *Computer models, Data processing, Groundwater, Leakage, Water table, Aquifer, Aquicludes, River, *New Mexico.

The computer program documented in Open-File Report 80-421 has continued to evolve in response to needs. By January 1981, changes included the following: (1) treatment of head-dependent boundaries and specified-flow boundaries and (2) code which executes on the CRAY-1 computer. This report provides instructions for compiling and executing the computer program on the CRAY-1 at Kirtland Air Force Base. (USGS)
W84-00678

SELECTED HYDROLOGIC DATA FOR NORTHERN UTAH VALLEY, UTAH, 1935-82,
Geological Survey, Salt Lake City, UT. Water Resources Div.
L. Appel, D. W. Clark, and P. E. Fairbanks.
USGS Open-File Report 82-1023, 1982. 94 p, 2 Fig, 8 Tab, 4 Ref.

Descriptors: Water resources, *Utah, *Groundwater, Surface water, *Water quality, Discharge, *Water levels, Water-resources data, Lehi, Provo, Orem, Utah Valley, Utah County, *Utah.

Presented are hydrologic data collected in northern Utah Valley from 1935 to 1982. The data include records of selected wells, springs, drains, irrigation ditches, streams, water quality, and drillers' logs of selected wells. Some of the data were previously published by the Geological Survey and cooperating agencies. (USGS)
W84-00681

8. ENGINEERING WORKS

8A. Structures

HYDROPOWER IN PORTUGAL: PROSPECTS FOR LARGE RESERVOIRS,
Coimbra Univ. (Portugal).
J. L. Serafim.
International Water Power and Dam Construction, Vol 35, No 2, p 40-42, February, 1983. 3 Fig, 2 Tab.

Descriptors: *Water resources development, *Reservoirs, Portugal, Rivers, Hydroelectric power, Design criteria, Cost anlysis, Economic aspects.

Areas and rivers in the country of Portugal where the most cost effective development of hydropower is likely to take place are described. The waters of rivers coming from Spain constitute a very appreciable hydraulic resource. In addition, good reservoirs and dam sites exist in paleozoic and granitic rocks, providing substantial hydroelectric resources to Portugal. The irregularities of rain and flow from the north to the south of the country, and from winter to summer and from year to year, make it appropriate to construct large reservoirs, high dams and powerful plants. The overall theoretical hydroelectric potential of the country for a year of average precipitation has been estimated as 32000 GWh, of which only about 30% is being exploited. Installed capacity is around 2300 MW in 25 large hydro plants of over 10 MW capacity. To obtain such a large amount of power, in a country of 89000 sq km area it will be necessary to build about 46 new large powerplants and dams, to increase substantially the installed capacity in at least 10 existing plants and to use around 80 small-scale systems, either existing or new, of less than 10 MW capacity. At present, because of the lack of funds, difficulties in buying inundated land, delays in international agreements and other reasons, there are only two hydropower stations under construction. (Baker-FRC)
W84-00413

PINPOINTING PIPE RUPTURES,
Compagnie Generale des Eaux, Paris (France).
A. Divenot.
Water/Engineering and Management, Vol 129, No 12, p 36-37, 1982. 4 Fig.

Descriptors: *Pipelines, *Rupturing, *Computers, Mechanical failure, Automation, Monitoring, Mathematical equations.

A method based on the use of a mathematical network model has been developed to locate ruptures in water distribution pipes quickly and accurately. It has two advantages over the established trial and error process. Not only do the automatic measurements preclude any need for human intervention, they also provide results of better quality, as they make a universal search instead of calculated point-by-point searches. Of the various data stored in a typical distribution system control computer, the most relevant are the flow rates at the supply sources and the pressures measured at the sources and in the system. The cumulative total of these flow rates is equal to the network's instantaneous consumption. Unfortunately, every process based on knowledge of the flow from a break indicated by variation of the source flows has the serious drawback of not being applicable when one of the flowrate sensors is unavailable for one reason or another. But if the search is based on pressure sensors, shutting down one or even several of them does not make the system inoperable. (Baker-FRC)
W84-00488

RECOMMENDED STANDARDS FOR WATER WORKS.
New York State Health Department Bulletin 42, Health Education Service, Albany, NY, 1982. 88 p, 1 Fig, 1 Tab.

Descriptors: *Standards, *Guidelines, *Design standards, *Specifications, *Water supply systems, *Engineering, Water supply development, Water storage, Pumping plants, Chemical treatment, Distribution.

These standards are intended to serve as 1) a guide in the design and preparation of plans and specifications for public water supply systems, 2) to suggest limiting values for items upon which an evaluation of such plans and specifications may be made by a reviewing authority, and 3) to establish, as far as practicable, uniformity of practice. The standards given are for submission of plans, general design considerations, pumping facilities, finished water storage and distribution systems. In addition, the manual contains policy statements on: 1) Package water treatment plants for public water supplies, 2) organic removal treatment for public water supplies, 3) ozonation for public water supplies, 4) distribution system corrosion control for public water supplies, and 5) salt storage for highway use and public water supplies. (Garrison-Omniplan)
W84-00501

HIGH WOOD RESERVOIR--PLANNING, DESIGN AND CONSTRUCTION,
N. C. Pasley.
Water Services, Vol 87, No 1043, p 11-12, 15-16, 18, January, 1983. 4 Fig, 2 Tab.

Descriptors: *Reservoir construction, *Soil properties, *Concrete, Water storage, Reservoir design, Design criteria, Construction, High Wood Reservoir, Excavation, *United Kingdom.

The planning, design, and construction of the High Wood Reservoir, upstream of the River Itchen, United Kingdom, is described. The 135 m liter concrete storage reservoir was built to protect the treatment works influent against gross river pollution, provide a 2 days' supply, and smooth out variations in river water quality. The foundation soil was cohesive, inorganic, and medium to highly plastic, with low coefficients of compressibility and volume change. A 600 m long, 5 m deep perimeter drain was used to dewater the site and to control the groundwater level, which was near the surface. Two grades of concrete were specified, one for the mass concrete and blinding concrete and the other for reinforced concrete. A total of 65,000 cu m of soil was excavated and incorporated into the reservoir banks. (Cassar-FRC)
W84-00563

COMMODITY PIPELINES MAY AID WATER DEVELOPMENT.
World Water, Vol 5, No 12, p 38-39, 41, December, 1982. 1 Tab.

Descriptors: *Pipelines, *Water transport, *Developing countries, Transportation, Water conveyance, Conduits, Slurries, Aquatrain.

The Aquatrain is a method of commodity pipeline transport being tested by the W. R. Grace Company. It proposes to move coal packaged in heavy duty plastic bags and carried by high pressure water flow through a 1 m pipeline from mines in Colorado to California. Fresh water for the first leg of the transport would come from the Yampa River in the Rockies. At Rifle the Yampa waters would be used for municipal supplies or discharged into the Colorado River. Water for the remainder of the line would be obtained from a saline Colorado tributary and be discharged, after recovery of the coal bags, into the Pacific. Other developments in pipeline transport include a more viscous slurry to help keep larger particles in suspension and movement of agricultural products, such as cocoa pods. In developing countries poor roads and lack of railroads make the pipeline alternative attractive. Commercial slurry pipelines of lengths up to 439 km currently move coal, limestone, ores, and other mineral products in the U.S. and many foreign countries. (Cassar-FRC)
W84-00565

8B. Hydraulics

MAINTAINING TIDAL INLET CHANNELS BY FLUIDIZATION,
Lehigh Univ., Bethlehem, PA. Dept. of Civil Engineering.
R. N. Weisman, A. G. Collins, and J. M. Parks.
Journal of the Waterway, Port, Coastal and Ocean Division, Proceedings of the American Society of Civil Engineers, Vol 108, No WW4, p 526-538, November, 1982. 9 Fig, 11 Ref.

Descriptors: *Fluidization, *Channel improvement, *Sediment control, Sand, Tidal hydraulics, Navigation canals, Corson Inlet, *New Jersey, Pipes, Inlets.

A navigable tidal inlet channel was stabilized by a fluidization technique, an alternative to channel dredging. Laboratory and field studies were based on a process using pipes with small holes drilled at frequent uniform intervals, placed in the ebb tide channel at a navigable depth. Water is pumped into the pipe to fluidize the sand above the pipe, which is then removed by pumping, flowing down a gradient, or sweeping out to sea with the ebb tide. For sand of 0.4 mm diameter, laboratory studies established a fluidization hole size of 0.316 cm, hole spacing of 5.08 cm, and a pipe flow rate of 4 liters per sec per m of pipe (greater for larger diameter sands), pipe diameter of 15.2 cm, pipe length of 12.2 m, and separation of parallel pipes of 1.83 m. Field tests run at Corson Inlet, New Jersey, showed that the full-scale system should have a pipe spacing of 3 m with sequential pumping through pairs of parallel pipes. Problems encountered were clogging of the holes with algae, sucking of sand into the pipe, and armoring around the pipes with clam shells. (Cassar-FRC)
W84-00580

8C. Hydraulic Machinery

LASER MEASUREMENTS FOR KAPLAN RUNNERS,
Voith G.m.b.H., Heidenheim (Germany, F.R.)
F. L. Brand, and H. Selbach.
International Water Power and Dam Construction, Vol 35, No 2, February, p 21-23, 1983. 9 Fig, 1 Tab.

Descriptors: *Lasers, *Measuring instruments, *Velocimeters, Data acquisition, Data collection, Hydraulic machinery, Hydraulic equipment, Turbines, Pumps, Flow.

An advanced laser velocimeter with an efficient data acquisition system is described. The velocimeter has been used in Germany to make measurements in the runner of a Kaplan water turbine. The effects of laser power and scattering particles on the measurements are examined, and the velocity distributions obtained within the blade passage are discussed. Measurements were performed in a model used for testing the hydrodynamic characteristics of different runner designs. One point of investigation was the laser power needed for measurements. The output of the laser was monitored using the built-in power motor. The laser power in the measuring volume was 70% of the power available at the laser output. At low light levels, random fluctuations in the level of flare light or current spikes in the photomultiplier tubes produce signals the magnitudes of which are equal to or greater than those of a typical particle in the water flow. The experiments demonstrated that laser design is well suited for the determination of velocity, flow angle, and turbulence in water turbines. These results are consistent with the results obtained from Pitot static probes and theoretical considerations. The laser measurement technique allows systematic investigation of flow phenomena in the rotor blade rows of water turbines or pumps. (Baker-FRC)
W84-00394

HIGH-HEAD PUMP-TURBINES: FRENCH EXPERIENCE,
Societe Neyrpic, Grenoble (France). Electricity Dept.
S. Casacci, N. Roche, and P. Jarrland.
International Water Power and Dam Construction, Vol 35, No 2, p 31-40, February, 1983. 14 Fig, 4 Tab.

Descriptors: *Turbines, *Construction, *Design criteria, Powerplants, Pumps, Mechanical equipment, Water resources development, Energy.

Features of high-head pumped-storage plant design are reviewed. The advantages and disadvantages of fixed vane multi-stage turbines are considered. The Le Clou plant, being designed in France at the present time serves as an example. Details are also given about the construction of underground penstocks and powerhouses for high-head pumped-storage plants. Several types of machines may be used to equip these hydroelectric powerstations: multi-stage pump-turbines with fixed, non-adjustable distributors; and single or two-stage adjustable vane pump-turbines. The main features of the Le Truel prototype unit with two adjustable stages are discussed including rotational speed, delivery head, pump delivery, turbine head, turbine output, and runner diameter. Design studies dealing with two-stage pump-turbines for the Le Clou power station are considered and characterized essentially by the nature of the forces involved which are: static loads acting on the embedded parts; and dynamic loads applied in particular to the gate mechanism components, the runner vanes, the shaft line assembly and the bearings; both guide and thrust bearings. For sizing the pump-turbine, knowledge of the extreme conditions occurring during operation of pumped-storage stations are considered including stationary parts, wicket gates, and rotating components. Details are also included regarding generator-motors, unit starting for pumping operation, underground power station concept, and underground penstocks. (Baker-FRC)
W84-00409

MEASURING SWIRL IN PUMP MODEL STUDIES,
E. Chang.
World Water, Vol 5, No 12, p 42-43, December, 1982. 4 Fig.

Descriptors: *Pumps, *Flow pattern, *Rotational flow, Hydraulic machinery, Impellers, Model studies, Vortices, Flow velocity.

Pump intake model studies are generally conducted with a geometrically-scaled suction pipe or siphon pipe without including a model rotation pump impeller. This assumes that the impeller has no upstream effect on the flow by adding to the approach swirl or increasng vortex activity and does not produce any prerotation. Experiments revealed that the impeller produces no prerotation from the design flow to 1.5 times the design flow. However, if pumps are to be operated at flows less than 50% of design flow, the impeller must be modeled. (Cassar-FRC)
W84-00566

PIPELINE CLEANING AND MAINTENANCE - NEW EQUIPMENT, NEW IDEAS,
R. W. Edwards.
Water Services, Vol 84, No 1013, p 418-423, July, 1980.

Descriptors: *Sewer systems, *Pipelines, *Maintenance, Cleaning, Water mains, Conveyance structures.

Technological innovations in servicing sewers and pipelines are summarized. A dual-purpose vehicle for cleaning sewers has dispensed with the separate suction unit and saves capital, operational, and maintenance costs. One crew can carry out high-pressure jetting and suction removal of deposited silt. One such unit is equipped with a jetting control panel, gauges for vacuum and air pressure, and indicators for water, sludge, and hydraulic-oil levels. This unit is built on a 16 ton chassis with a diesel engine and five speed gear box. A new relining process for water mains is the use of epoxy resin rather than the well-established practice of bitumen relining. The resin possesses many desirable features for pipes up to 30 mm in diameter. It has an estimated life of 30 years and can be applied cheaply. A major advantage of the new process is its speed. Another innovation is the use of flexible pigs for cleaning trunk mains. On a short trial run, a pig designed for 812 mm to 914 mm diameter pipes operated successfuliy with a pressure head of less than 1.8 m to set it in motion. (Small-FRC)
W84-00589

EFFICIENCY PERFORMANCE CRITERIA FOR IRRIGATION SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Agricultural Engineering.
H. J. Hansen, and M. N. Shearer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-132455, Price codes: A04 in paper copy, A01 in microfiche. Water Resources Research Institute Publication WRRI-90, Oregon State Univ., Corvallis, November 1983. 82 p, 5 Fig, 7 Tab, 22 Ref, 13 Append. OWRT B-070-ORE(1), 14-34-0001-9157.

Descriptors: *Pump testing, *Pumping plants, *Pumps, Irrigation, Irrigation efficiency, Irrigation engineering, *Irrigation operation, Irrigation practices, *Oregon.

The efficiency performance levels of existing irrigation pumping plant systems in Oregon were determined from tests of selected systems under field operation conditions. Usable test data were obtained from 529 units out of 545 tested. The overall plant efficiency ranged from 14 to 79 percent. Twenty-eight percent of the centrifugal and 34 percent of the turbine pumping plant systems had efficiencies of 65 percent or greater. Twenty percent of the centrifugal and 23percent of the turbine units were operating under 50% efficiency. A 65% overall plant efficiency is generally considered achievable. Units under 50% efficiency generally warrant consideration for repair or replacement. The two primary causes of low overall plant efficiencies were (a) improperly designed or sized fittings around pumps (only 38% were rated satisfactory) and (b) mismatches of pump and sprinkler systems. Very often, laterals had been added, deleted or changed without making pump adjustments. Pump efficiencies ranged from 24% to 87% with 68% operating above 60% efficiency. Comparing individual pump performance with the specific manufacturer's pump curve revealed that 55% of the pumps were operating within 4% of their respective curves -- a very acceptable performance range.
W84-00593

8F. Concrete

CORROSION PROTECTION OF CONCRETE AND STEEL TANKS AND RESERVOIRS.
For primary bibliographic entry see Field 8G.
W84-00590

8G. Materials

HOW TO MAINTAIN PVC SEWER PIPE,
W. D. Nesbeitt.
Water and Pollution Control, Vol 118, No 10, p 22-25, October, 1980. 2 Fig.

Descriptors: *Plastic pipes, *Maintenance costs, *Sewerage, Pipelines, Hydraulic structures, Sanitary engineering, Maintenance, Corrosion.

A review of the maintenance requirements for polyvinyl chloride (PVC) sewer pipe manufactured to meet ASTM D3034(DR35) standards is presented. The PVC sewer pipe's response to aggressive environments commonly found in gravity-flow sanitary sewer systems is evaluated, and some cost-effective maintenance procedures for PVC sewer systems are recommended. The most commonly experienced aggressive environment problems of sanitary sewer systems include root intrusion, infiltration, excessive slime accumulation, grease deposition, grit accumulation and corrosion. Tests conducted to evaluate the integrity of PVC sewer pipe gasket joints in situations of excessive deflection caused by severe earth loading showed that PVC piping with properly installed gaskets was not subject to root intrusion problems. Similarly, slime accumulation and infiltration occurred relatively infrequently in PVC sanitary sewer pipes. The greatest concern with slime accumulation is the production of sulfuric acid, which often causes pipe corrosion. PVC pipe was not usually subject to sulfuric acid corrosion. Methods of slime and grease removal by mechanical blockage removal equipment showed only slight damage, in some cases, to PVC pipes. PVC pipe is also highly resistant to abrasion in gravity systems, low in maintenance costs, and easy to install. A maintenance schedule of periodic inspection, visually or by television, and periodic preventive measures such as 'ball', rod, 'pig', or high pressure cleaning are recommended. (Geiger-FRC)
W84-00522

THE ECONOMICS OF LEAK DETECTION AND REPAIR - A CASE STUDY,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
E. E. Moyer, J. W. Male, I. C. Moore, and J. G. Hock.
Journal of the American Water Works Association, Vol 75, No 1, p 29-34, January, 1983. 2 Fig, 7 Tab, 13 Ref.

Descriptors: *Leakage, *Economic aspects, *Pipelines, *Maintenance costs, *Case studies, *Cost-benefit analysis, Water loss, Water conveyance, Pipes, Water mains, Maintenance, Water conservation.

A case study of the Westchester Joint Water Works (WJWW) in Mamaroneck, New York, is presented to demonstrate the favorable economics of systematic leak detection and repair of a water distribution system and to offer some insights into leak characteristics and the accuracy of sonic leak detection. Records of surveyors at the time of leak detection, repair crew reports and general records of water usage, costs, and unaccounted for water were reviewed in order to calculate costs and benefits in each year of leak detection. Simple statistical analysis showed that leakage stopped by WJWW saved a net amount of $239,052 over a six-year period. Leaks were classified into six categories and the net economic benefit or loss of repairing each type of leak was estimated. The accuracy of sonic leak detection in determining leak size and

location were obtained by statistically comparing survey and repair reports and the actual location of the leak with that predicted by the survey. On the whole actual and predicted leak locations correlated closely. Other possible tangible and intangible benefits of leak detection and repair include decreased damage to property, lesser loads on treatment facilities, lower total repair costs, decreased total demand, reduced risk of contamination, water conservation and decreased expenditures on leak related expenses. (Geiger-FRC)
W84-00582

CEMENT-BASED SEALS FOR THERMOPLASTIC WATER WELL CASINGS,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
C. E. Kurt.
Water Well Journal, Vol 37, No 1, p 38-40, 1983. 2 Fig.

Descriptors: *Well casings, *Cement, *Construction, *Thermoplastics, Seals, Grout, Wells, Casings, Well water, Well seepage, Well regulations.

Cement-based grouts have been used to seal the annulus between the well casing and the native formation. The placement of this seal is crucial. A grout seal may be required along the entire length of the casing. In other applications only the top 10 or 20 feet of the well casing must be grouted. The purpose of these requirements is to minimize the amount of surface water that can travel through the casing annulus. When it is important that the water from one aquifer not be permitted to flow into another aquifer, only sections of the annulus need to be grouted along the length of casing. When using thermoplastic materials for water well casings the seal provides another very important function. While thermoplastic water well casings have a long history of excellent service in the water well industry it is important to know that they are not as strong as steel casings. For any casing system there are several potential paths for water and contaminants to follow in the annulus along the casing. One path is through the grout material itself. If the best materials are improperly installed a highly permeable seal can result. The property used to measure the flow of fluid through a porous material such as a grout seal is called the coefficient of permeability. It measures the amount of fluid passing through a porous media per unit cross sectional area in a period of time when subjected to a pressure head. A direct approach to demonstrate a good seal is to pressure test the casing. (Baker-FRC)
W84-00586

CORROSION PROTECTION OF CONCRETE AND STEEL TANKS AND RESERVOIRS.
Water Services, Vol 84, No 1010, p 238, 241, April, 1980.

Descriptors: *Protective coatings, *Concrete technology, *Corrosion control, Coatings, Steel, Storage tanks, Wastewater treatment facilities, Reservoirs, Potable water, Epoxy resins.

The useful life of concrete and steel water storage tanks and reservoirs can be prolonged with effective corrosion protection. Sewage handling structures are increasingly exposed to higher temperatures and modern detergents, which increase the power of the sewage to penetrate the concrete surface. Many coatings (epoxy, chlorinated rubber, and coal tar pitch-epoxy) are available for these applications and must be specified according to conditions encountered. Best results are obtained when coatings are applied to properly cleaned surfaces, using the specific method for the material involved. Engineers should use only specialized, experienced contractors who have detailed knowledge of coatings application. It is helpful if these coating specialists are consulted during the planning stage. (Cassar-FRC)
W84-00590

8I. Fisheries Engineering

AQUACULTURE TECHNIQUES: PRELIMINARY STUDIES ON CARRYING CAPACITIES AND CENSUS-TAKING IN SERIAL REUSE PONDS,
Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
G. W. Klontz, C. M. Herr, and T. J. McArthur.
Available from the National Technical Information Service, Springfield, VA 22161 as PB84-120823, Price codes: A04 in paper copy, A01 in microfiche. Idaho Water and Energy Resources Research Institute Completion Report, Moscow, July 1983. 45 p, 5 Fig, 10 Tab, 18 Ref. OWRT A-075-IDA(1), 14-34-0001-2114.

Descriptors: *Oxygen consumption, *Aquaculture, *Rainbow trout, *Pond census-taking, Model studies, *Carrying capacity, Dissolved oxygen, Flow rates, Water temperature, Fish size.

A fish size and water temerature compensated model to measure the oxygen consumption of rainbow trout was developed and tested under laboratory and limited field conditions. The model is log mg/hr 0 sub 2 consumption = 0.847532 + 0.8428 log g/fish + 0.03733C. Although the model is logically and mathematically correct, several technical inaccuracies were detected when the model was applied to determine the number of rainbow trout in a raceway population. These inaccuracies were attributed to the sensitivities of the methods used to determine the dissolved oxygen concentrations and flow rates of the water entering and leaving the systems. Further studies are planned.
W84-00432

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